for . .

engineers and contractors controlling the design, specification, installation and maintenance of heating, ventilating and air conditioning.

HEATING AND VENTILATING

The Air Conditioning Monthly

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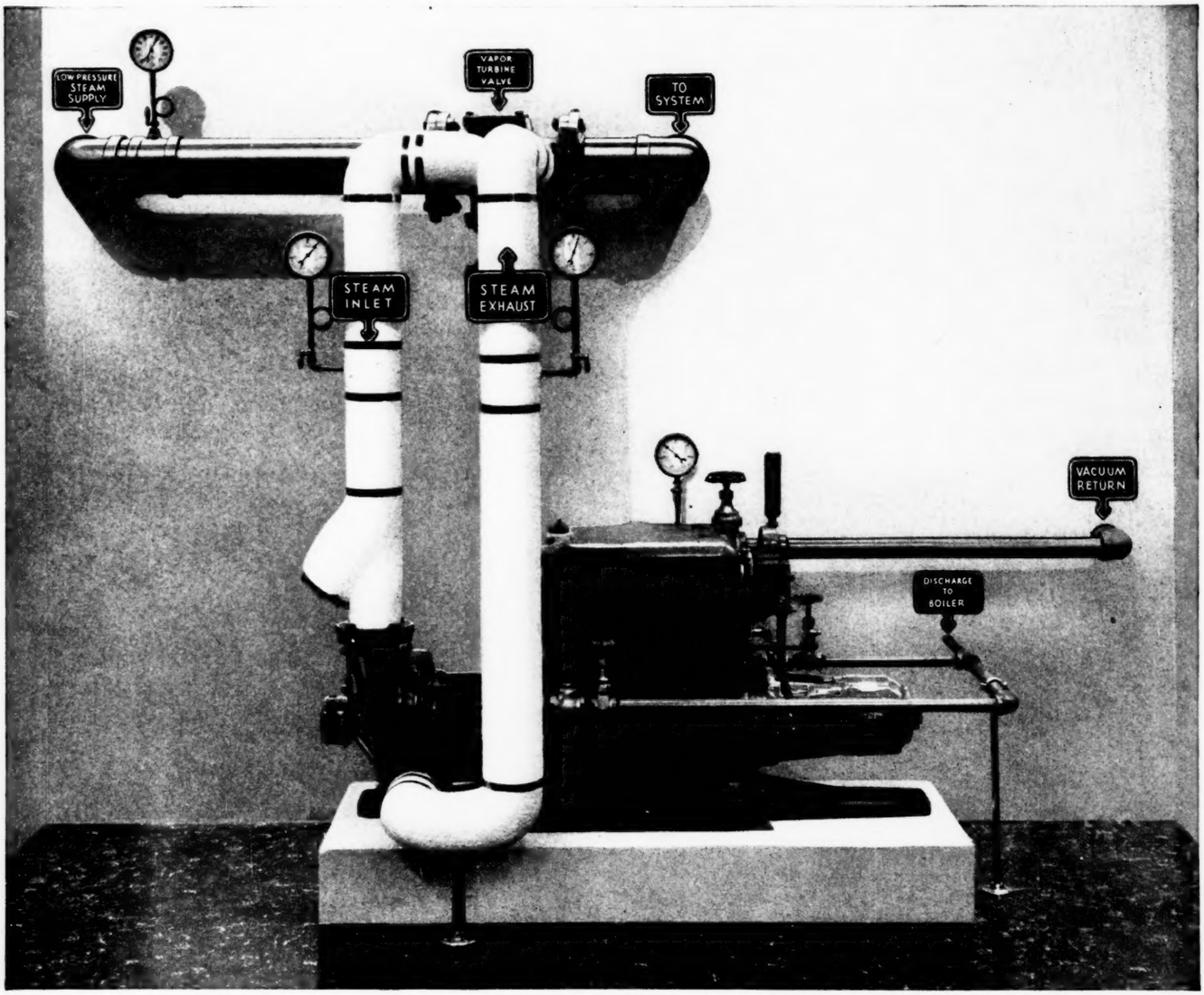
Where Heat Must Not Fail— Install this SAFE Heating Pump!



In Hospitals, Greenhouses, Schools, Public Buildings, Theatres, wherever heating systems must not fail, install the Nash Vapor Turbine, for it is independent of electric current failure, and continues to operate as long as there is steam in the system.

This is because the prime motive power of this economical pump is a special steam turbine, controlled by a unique "Vapor Turbine Valve", which automatically bypasses from the heating main a small portion of steam, the exact amount necessary to develop the power needed to remove the condensate and maintain the required vacuum on the system. Even this small amount is passed immediately back to the mains, and goes on to the system with little heat loss. This pump operates on any system, high or low pressure.

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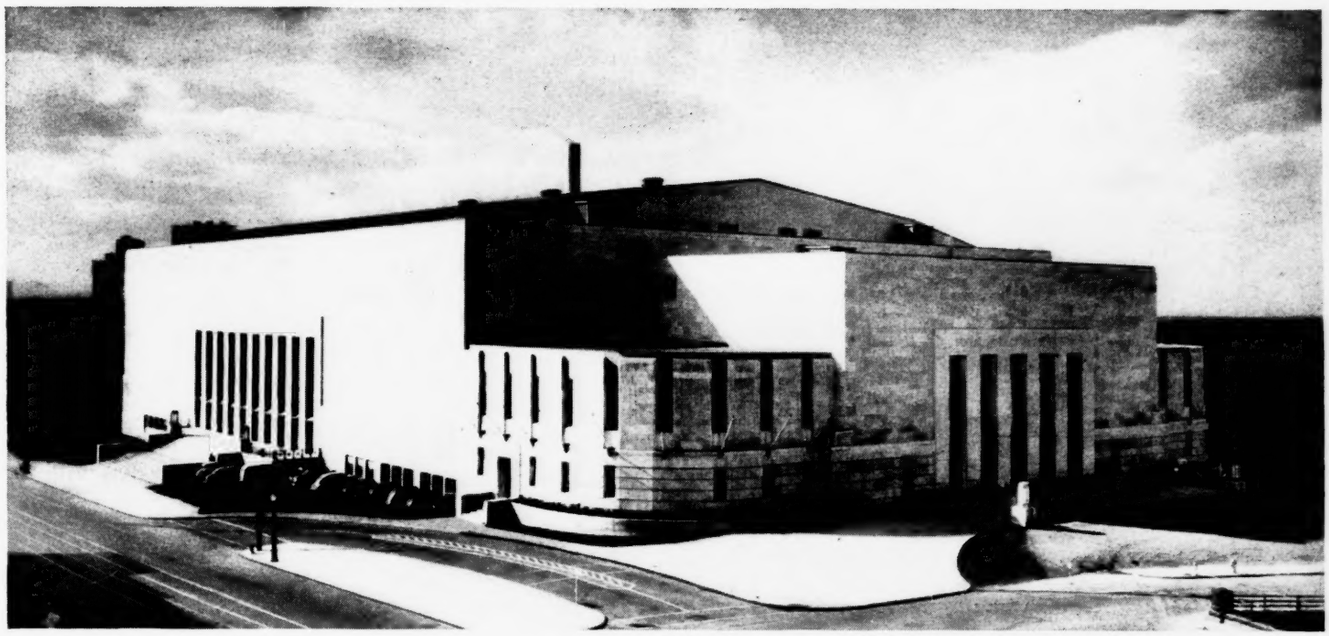


The Buffalo Auditorium as seen from the northeast.

Myron C. Beman† *describes the*

BUFFALO MEMORIAL AUDITORIUM

which has an Arena, seating 14,000, equipped for ice-skating. Fan system used for heating, night air for cooling. Boilers are stoker-fired.

EVERY large city sooner or later has to meet the need of a civic auditorium for housing conventions, meetings, exhibitions, sports of many kinds and space for various entertainments. Buffalo has met these requirements so admirably that its Memorial Civic Auditorium is recognized as one of the few all purpose buildings of this type in the country.

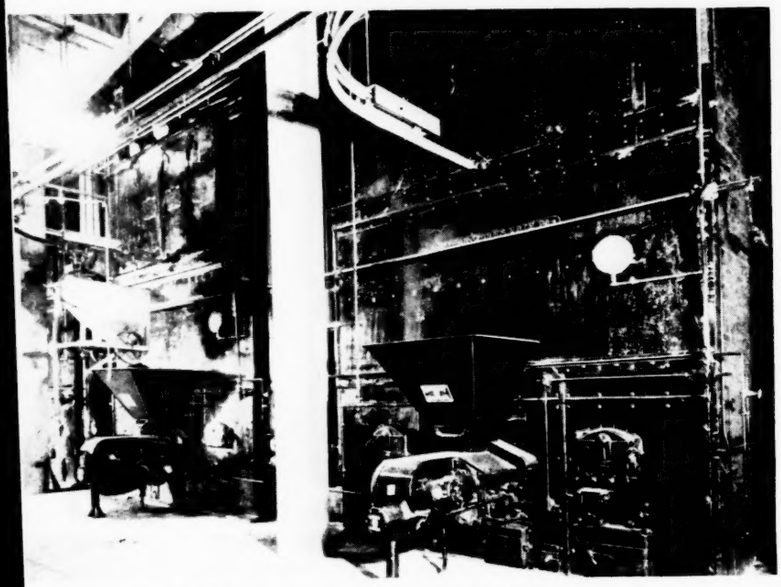
A civic auditorium presents special heating and ventilating problems. In addition to providing comfortable temperature and air conditions for people moving about at an auto show or seated in tiers at a convention, there is smoke from hundreds of pipes, cigars and cigarettes to be exhausted. There are committee rooms, offices and small halls requiring heat at times when the larger spaces do not, necessitating zoning. And when, as is the case in Buffalo, the floor of the Arena for a good many nights in the year becomes an ice rink, there is refrigeration to be reconciled with the heating design. In Buffalo, moreover, the auditorium, an Ohio limestone structure in the down town business district, is near the water front, so that exposure to lake winds and storms had also to be taken into account.

The Arena is the largest section of the building, seating 14,000 people with every seat arranged so that the occupant can see the main floor. Permanent balcony seats are upholstered in colors to differentiate the sections, the red being the lowest tiers, with blue next and the gray under the roof. The color scheme has a decorative effect and is useful, by ticket coordination, in the swift seating of an audience. It is used in this article in describing the heating and ventilating arrangements.

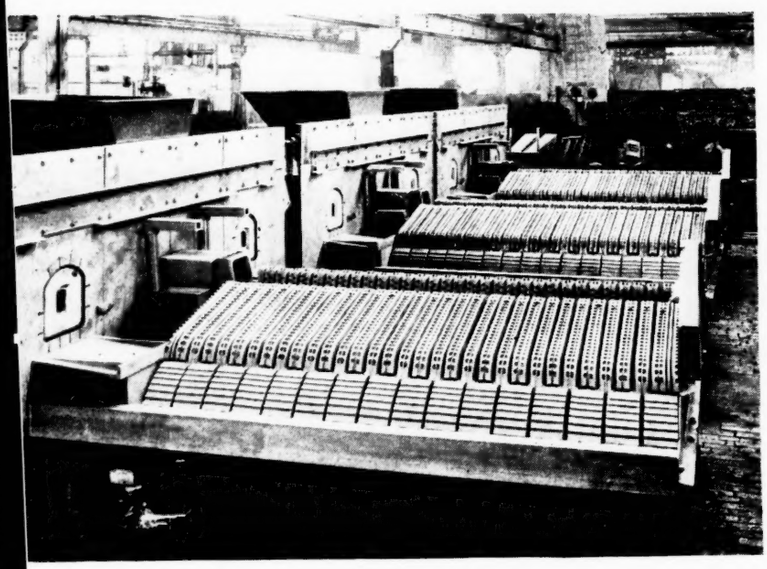
The Arena floor is polished terrazzo; under the center section refrigeration pipes are run for the skating rink, the rink section being separated from the rest of the floor by a compressible rubber expansion piece which has prevented any unevenness or deterioration in the floor composition. Water is sprayed on the terrazzo and frozen in layers until the skating surface is

†Beman & Candee, Consulting Engineers, Buffalo.

Interior of Arena set up for skating fantasia.



Boiler, stoker and coal handling arrangement in Boiler Room.



Stoker assembly ready for installation.

about ½ in. thick. This, by proper control of the brine temperature, provides exactly the hardness necessary to maintain a suitable surface.

At the south end of the Arena under the balcony is the Control Room with three glass fronted compartments. The center one is arranged for the use of the production manager of whatever event is on in the Arena and is provided with telephones, and other contacts to enable general control of an event. It connects on the right with the Electric Control Room which contains the light switches, equipment for the control and use of the public address and radio systems, score board and central lighting cubicle. The compartment to the left houses the heating and ventilating control with its fan speed buttons; the indicating thermometers which record temperature and humidity in various parts of the Arena; and the Johnson Service pneumatic temperature control which governs the dampers and the readjustable temperature control.

The big open space of the Arena is heated and ventilated by four units, one in each of the corner Fan Rooms located on a level with the highest seats and extending up into the truss space. The balance of the heating system is of the vacuum type, divided into six zones and served by as many vacuum pumps located in the basement near the Boiler Room. Each fan unit consists of a double Buffalo Forge fan, Nesbitt tube-within-a-tube bank of tempering coils and bank of reheating coils with by-pass and a sectional Universal filter, using renewable glass fireproof filtering media.

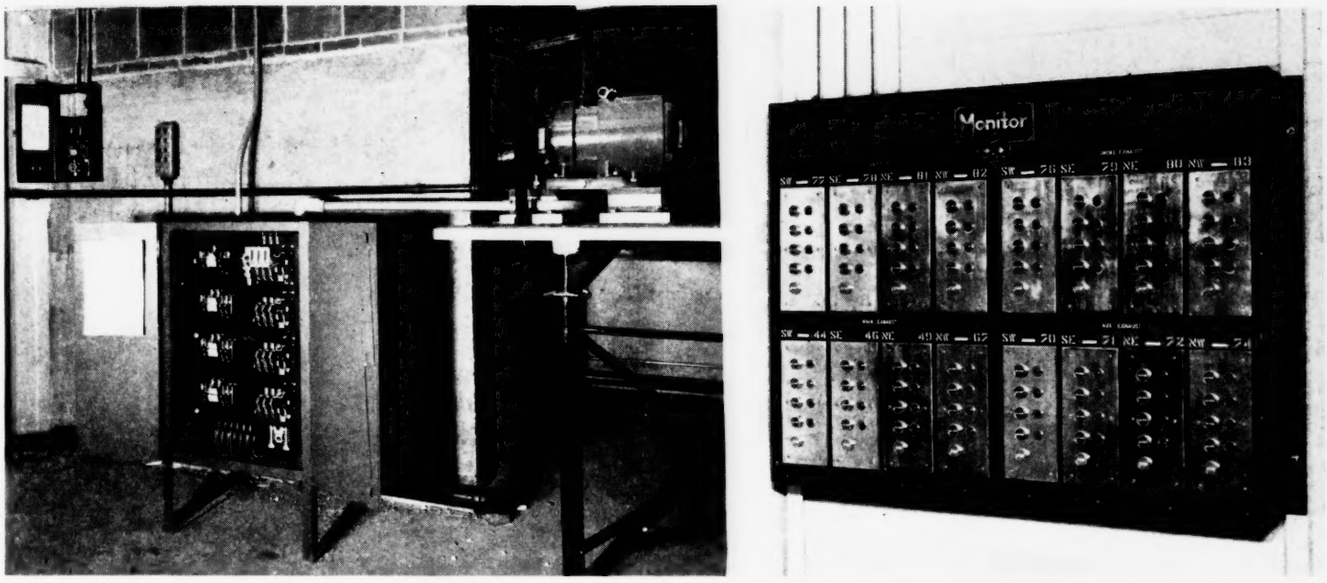
The air, received from outside through louvers and face damper, is admitted below the Fan Room floor and drawn through a grating to the filter section.

There are three exhaust fans for each supply fan unit, the largest exhausting air from under the balcony and back of the first aisle to the rear of the red seats. The second exhaust fan takes the air from the corridor ceilings under the blue and gray seats and through the upper and lower vomitories to outlets placed directly in line in the ceiling of the corridors behind each vomitory. The third fan is in the truss space over the gray seats and is used as a smoke exhaust fan as well as a ventilating fan.

The damper arrangement for controlling the air from the exhaust fans is such that the air may be either returned to the inlet space of the supply fan or exhausted to outdoors. With this setup it is possible to use all outside air, partially recirculated air with outside air, or all recirculated air; and, by the selection of the exhaust fans, to determine how far from the outlets the supply air will be drawn into the building. This flexibility makes it possible to heat the floor for exhibitions, shows, conventions, etc.; or, when the rink is in use, to draw the air to the balcony level so as not to raise materially the temperature over the ice. By this means, less refrigeration is required to keep the ice in condition and it is possible to have comfortable temperature for the spectators at such times.

While no refrigeration is provided for cooling the air, a great deal of cooling has been done, particularly at night, by the use of the supply fans to bring in the proverbially cool Buffalo evening air.

Variation in the dampers of the exhaust fans keeps



(Left) Electric control for Exhibition Room fan motor—typical of all fans. (Right) Fan speed controllers in Control Room.

the Arena free from smoke and counteracts any tendency to build a fog over the ice. It makes control so flexible that the operator has been able to meet all conditions of varying occupancy. There are three large roof ventilators under pneumatic damper control which are useful at times for further controlling the Arena heating and ventilating, smoke conditions, and during times of use of all outside air.

Fan speed control is operated from the Control Room by the Monitor starting buttons which in turn operate different across-the-line switches, giving 4-speed control of each main supply and of each exhaust fan.

Dampers are operated by the Johnson Service pneumatic control system which also regulates the temperature of the air from the supply fans by means of pilot operated valves on the steam supplies of the heating coils. Dampers are positioned from the temperature control panel for any arrangement desired by means of positioning damper switches.

To check the temperature in various parts of the building a multiple series of resistance thermometers are brought through an adjustable switch to an indicating thermometer which gives the operator the temperature at the location of such thermometers in the Arena; and in addition gives wet and dry bulb readings for the air coming from each supply fan.

As an economical operating arrangement for maintenance, building cleaning and rapid heat-up, four recirculating unit heaters are placed under the balcony. Due to the zoning and fan control, any special section of the building being used at a given time can be heated, while maintaining only sufficient heat for stand-by purposes in other sections.

The Boiler Room is located in the southwest corner of the building and contains three — 400 hp long-drum Union Iron Works straight tube boilers fired by means of Detroit single retort, continuous, side dumping stokers under automatic control. Coal is supplied to the stoker hoppers by means of an electrically driven trolley bucket extending into the coal bunker over which extends a railroad siding.

The boilers are built for 160 lb working pressure and operated at 100 lb. Steam mains to the fan heaters pass through reducing valves which reduce the boiler pressure to 50 lb for distribution throughout the heating system. In the Fan Rooms further reduction is made to 5 and 10 lb for the heating coils, while the radiator supply lines are operated at 2 lb pressure through reducing valves located at the different zones into which the radiator heating system is divided.

Radiators are placed in general throughout the Committee and Locker Rooms under the Arena balcony and on the ramps, while in the north end of the building where the small auditorium, meeting rooms and different offices are located, the heating is done primarily with radiation and ventilation is added by means of units and their heating coils, all under automatic temperature control. The Exhibition Room under the Arena, which practically duplicates the Arena floor space and is suitable for heavy exhibits, is heated entirely by the ventilating air from two fans placed in the south end, arranged with heating coils and filters for either outside or recirculated air.

The Engineer's control room is adjacent to the Boiler Room and contains 24 pilot switches connected to the starters at the various locations of toilet and other service exhaust fans. Outside this room are placed the Brown steam flow meters and other recording devices.

With the complete control of all heating and ventilating units to meet a wide variety of usage placed in the hands of the Operating Engineer, it has been possible to provide comfortable conditions for all types of occupancy. During its first year 1,300,000 people have been checked through the turnstiles and the city revenues have been increased $170,000.

BUFFALO MEMORIAL CIVIC AUDITORIUM
Commissioner of Public Works: Louis A. Harding
Architects: Green & James
Consulting Engineers: Beman & Candee

Power Costs Are Lower if Dust Exhaust Systems Are Well Balanced

By W. C. L. HEMEON†

It is not too difficult to design a dust exhaust system that will work. It is a little more laborious to design one that will work satisfactorily and at the same time operate economically. Probably 95% of the common troubles with dust exhaust systems (other than improper estimates of required air flow) occur because of lack of understanding of balanced flow. The author here shows that power consumption of a balanced system can be as little as one-third that of an unbalanced system, and he presents a clear-cut exposition of a method of designing a balanced system, the essence of which is the orderly tabulation of calculations. This article will be of special interest to industrial engineers interested in keeping power costs at a minimum.

BECAUSE the different branch ducts of the typical exhaust system must inevitably be located at varying distances from the fan and be connected by main ducts that occasion friction losses in the air stream, the flow of air through branches nearest the fan is facilitated and the flow through those more remote is impeded. Even more important differences in resistance are occasioned by several sizes of pipe for various branches. The result is that the friction losses through the various branches must be adjusted in order to attain the minimum air flow specified for the branch least advantageously located.

Method of Equalizing Friction

Such friction losses through each branch may be equalized (1) by restrictions in branch pipes (for example, dampers); (2) by systematic reduction of the diameter of some of the branch pipes; or (3) merely by exhausting greater than necessary volumes of air. The latter may be extremely wasteful both in first cost of equipment and in power for operation, a point which is to be illustrated graphically in this article. The second is the best method and is likewise described later.

In exhaust systems for control of dust, the necessity for preventing settlement of solid material in pipe lines introduces complications in the design of such systems that would not be encountered otherwise. As is well known, dust can be maintained in suspension just so long as the velocity of air in pipes is maintained above a critical value—the transporting velocity that is characteristic of a particular dust. For the majority of industrial dusts the minimum transporting velocity used in practical designs lies between 2500-4500 feet per minute, the commonest adequate velocities being approximately 3000-4000 feet per minute. These facts prevent indiscriminate reduction of the velocity in any branch as an aid to the suitable adjustment of branch resistance.

†Engineer, Division of Occupational Hygiene, Massachusetts Department of Labor and Industries.

Usual Design Methods

The first method, restrictions in the form of dampers permanently anchored to provide increased resistance in those branches requiring it is sometimes employed. This method will effect an economical system if intelligently applied but should not be used where large quantities of highly abrasive dust are handled, where large size objects are transported (e.g. some wood waste exhaust systems), or where the dust, though dry, has sticking characteristics, usually true of very fine powders (e.g. pigments, talc, lime, and the like).

The second design method in which diameters of branch pipes are systematically modified to effect desired friction losses is superior to any other but is infrequently applied. One reason for this is that usual calculation methods are laborious and can be very confusing when applied to a system of many branches. Furthermore, satisfactory operating results (excluding consideration of power cost) can usually be attained by the experienced engineer without elaborate calculations, by introduction of safety factors based on rules of thumb determined by the experience of the designer. The safety factor is usually in the form of a high average system velocity (wherein for a given air flow rate the pipe size selected determines the average air velocity). This is the third method referred to above which results in exhausting greater than necessary volumes of air and is sometimes excessively wasteful of power. Example 1 given below analyzes this method following which example 2 will demonstrate the preferred method mentioned above.

Modified-Branch-Size Method

Certain calculation methods for designing exhaust systems for predetermined air flows by modified branch sizes have been described by three or four writers. All (including the author's) are based on identical principles, differing only in the system of computation.

The method to be described has the advantage of

simplicity and is based primarily on an orderly arrangement of calculated data. It is easy to visualize the results and thus facilitates subsequent modifications.

Maximum convenience is essential. Long sheets of paper of convenient size and convenient rulings should be on hand for such use. Double foolscap size 17x11 in., ruled with horizontal and vertical lines, are convenient and readily available at stationers'. It is also desirable, when much work of the sort is done, to have printed line-titles for attaching to the left end of the data sheet.

Example 1

Before proceeding with the design of a most economical system involving modification of branch sizes, first consider a system in which no corrections are applied.

The exhaust system of Fig. 1 is laid out on the basis of approximately 3500 fpm velocity, in all branches and mains. This is the commonest design procedure and is based on the assumption that air flows through the various branches will be proportional to the sizes of the branch pipes. Thus, if branch 1 were planned to carry three times the volume of branch 2, then branch 1 would be made three times the size (in area) of branch 2, regardless of their relative locations in the system. It is therefore instructive to analyze the actual performance of a system based on this design, and in doing so we shall introduce the computation procedure that is the principal purpose of this paper.

The object of the present calculations will, therefore, be to determine the actual rate of air flow, hence air velocities, in all sections of the system, for the case where 3500 fpm is taken as the lowest permissible velocity in any branch. (This, obviously, is branch 1.) The results will also give the percentage distribution of the total air flow between various branches. Since this will remain the same regardless of variations in *total* air flow, we can then calculate the velocity in any branch for any other specified total air flow.

Calculation Procedure

The general procedure will be to compute the loss in head in each branch for *any arbitrarily selected air velocity*, taking the same velocity for every branch. This is done for the sake of simplicity, and in the example at hand will be 3500 fpm. Since air volume, Q, varies with the square root of the head loss, we will thus have determined the fundamental characteristic of each branch,

$$Q = K\sqrt{h_L}$$

which makes it simple to calculate what the actual air flow will be when the head loss in a given branch has any other specified value.

Data on friction and shock losses for various parts of exhaust systems are not a part of this paper and are therefore not reproduced. The reader wishing such information should consult other references, especially Alden*, a most comprehensive and concise text. Essential data for the design problem at hand is indicated on the table and diagram.

Detailed Steps

In considering the following explanatory notes, the reader should, for clarity, refer only to one vertical column of data at a time, starting with the first and proceeding through successive vertical columns. Directional arrows indicate the train of calculations.

Line 2—Set down the specified minimum rate of air flow, Q, for each branch. This is for reference only, and is not used directly in subsequent calculations.

Line 3—Pipe diameter; specified originally in present example as the nearest commercial size which would carry the specified air flow if the planned velocity were actually realized in the final system.

Line 4—Taking the selected pipe diameter, calculate the rate of air flow, Q, required to result in the specified pipe velocity, exactly (in present case, 3500 fpm). This Q is the one that will be modified in subsequent calculations. This, and preceding steps are based (a) on the impracticality of considering pipe sizes in other than even inches, or halves of an inch and (b) on the rule of this method that a "standard" velocity be utilized for preliminary calculations.

Line 5—Lines 6-10 are calculations of head loss for the "standard" velocity, which is 3500 fpm in this example (velocity head, $h_v = 0.76$ in.). This does not give the actual loss (except for branch 1) but merely the loss corresponding to the standard velocity (and air volume, Q).

Line 6—Hoods 1 and 2 are flanged pipes having entry loss of ½ velocity head. Hoods 3 and 5a, plain end pipes, whose loss is 1 velocity head. Hoods 4 and 5b are tapered nozzles having an entry loss of ¼ velocity head.

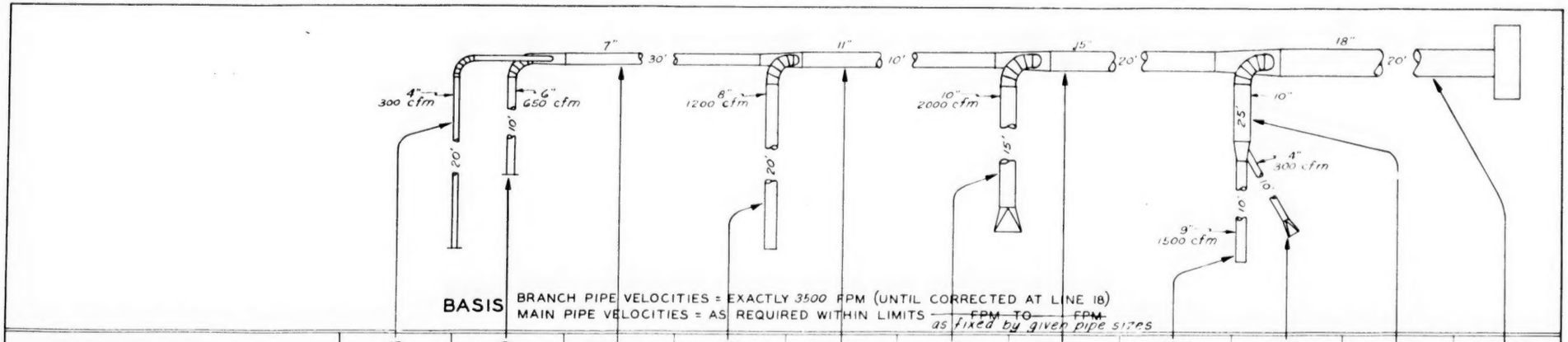
Line 7—From a standard friction loss chart (e.g., Alden pp. 84-85).

Line 8—Loss in 90° ells, radius of 1½ diameters, taken as 0.17 velocity head.

Line 9—Loss in stream passing from branch into main to a point beyond end of taper, taken as 0.22 velocity heads. Note that all losses, h_L, are actually differences in total pressures between two specified points, not static pressures.

Line 11—Velocity head is not included in this total, hence the figure represents only irretrievably lost energy. It is the difference between total pressure outside the hood (atmospheric pressure) and total pressure at the point in the main considered to be the calculation "end-point". It is represented by the reading that would be obtained by a simple total pressure tube at this point and when the fan is reached it represents the "fan static pressure" according to standard definitions. Some engineers do add velocity pressure at this point, which necessitates care in accounting for pressure transformations when important changes in duct areas are encountered; moreover, the total obtained at the fan is not the "fan static pressure" according to modern definitions.

*J. L. Alden, "Design of Industrial Exhaust Systems," published by The Industrial Press.



BASIS BRANCH PIPE VELOCITIES = EXACTLY 3500 FPM (UNTIL CORRECTED AT LINE 18)
MAIN PIPE VELOCITIES = AS REQUIRED WITHIN LIMITS ~~___ FPM TO ___ FPM~~ as fixed by given pipe sizes

		①	②	Main A	③	Main B	④	Main C	⑤a	⑤b	⑤	Main D
1	**BRANCH OR MAIN**											
2	PRELIMINARY Q (CFM) *(Planned)*	300 cfm	650 cfm		1200 cfm		2000 cfm		1500 cfm	300 cfm		
3	NEAREST PIPE DIAMETER	4"	6"		8"		10"		9"	4"	10"	
4	Q FOR CALCULATION (3500 fpm, h_v = 0.76)	305 cfm	687 cfm		1220 cfm		1910 cfm		1550 cfm	305 cfm	(5a+5b) 1884 cfm	
5	**BRANCH LOSS**										V = 3460 fpm, h_v = 0.75"	
6	HOOD ENTRANCE *(Given)*	0.5×0.76=0.38	0.5×0.76=0.38		1.0×.76=.76		25×.76=.19		1.0×.76=.76	.25×.76=.19	entrance loss) = loss in 5a+5b) = 1.08	
7	BRANCH PIPE FRICTION *(Data, friction chart)*	$5.4\times\frac{20}{100}=1.08$	$3.4\times\frac{10}{100}=0.34$		$2.5\times\frac{20}{100}=.50$		$1.9\times\frac{15}{100}=.29$		$2.2\times\frac{10}{100}=.22$	$5.4\times\frac{10}{100}=.54$	$1.9\times\frac{25}{100}=.48$	
8	ELBOWS *(17% velocity head / 90° L)*	0.17×0.76=0.13	0.17×0.76=0.13		.17×.76=.13		.17×.76=.13		—	—	.17×.75=.13	
9	ENTRANCE TO MAIN *(22% velocity head)*	0.22×0.76=0.17	0.17×0.76=0.13 (tee loss)		.22×.76=.17		.22×.76=.17		.13×.76=.10 (tee loss)	.22×.76=.17	.22×.75=.17	
10	OTHER											
11	**TOTAL LOSS** (BRANCH)	1.76"	0.98"		1.56"		0.78"		1.08"	0.90"	1.86"	
12	NEEDED MODIFICATION	None: this appears to be the key branch because loss is greatest for 3500 fpm, the selected "test velocity."	Loss in this branch must equal 1.76, therefore Q will increase beyond 687 cfm (3500 fpm) in proportion shown		But loss in main at this point = 3.43" (see line 28, previous column). Hence Q in this branch will increase beyond 1220 cfm (3500 fpm) until branch loss equals 3.43"		Loss in main is 3.97" (line 28, previous column) Hence Q must increase beyond 1910 cfm (3500 fpm) until equalized.		calculate 5b and 5 before final disposition	Actual air flow must increase beyond 305 cfm (3500 fpm) to make pressure loss equal 1.08"	But note pressure in main at this point (line 28, Main C) = 4.96" Hence air flow in this branch (and 5a, 5b) must increase.	
18	INCREASE / DECREASE Q TO EQUALIZE $\left(\frac{Q_2}{Q_1}=\frac{\sqrt{h_2}}{\sqrt{h_1}}\right)$		$Q=687\sqrt{\frac{1.76}{0.98}}$		$Q=1220\sqrt{\frac{3.43}{1.56}}$		$Q=1910\sqrt{\frac{3.97}{0.78}}$			$Q=305\sqrt{\frac{1.08}{0.90}}$	$Q=1884\sqrt{\frac{4.96}{1.86}}$	
20	**FINAL BRANCH Q**	305 cfm	= 921 cfm		= 1810 cfm		= 4310 cfm		following calculations for 5, it is seen that each of these must be increased in proportion 3080/1884		= 3080 cfm	
21	**MAIN**											
22	Q (MAIN)			1226 cfm		3036 cfm		7350 cfm				10,430 cfm
23	NEAREST PIPE DIAM *(Specified)*			7"		11"		15"				18"
24	VELOCITY (MAIN)			4580 fpm (h_v=1.32")		4600 fpm (h_v=1.32")		5980 fpm (h_v=2.23")				5910 fpm
25	FRICTION LOSS (MAIN)			$4.7\times\frac{30}{100}=1.41$		$2.8\times\frac{10}{100}=0.28$"		$3.3\times\frac{20}{100}=0.66$				$2.6\times\frac{20}{100}=.52$
26	TAPER-TEE LOSS (MAIN)			0.2×1.32=0.26		0.2×1.32=0.26"		0.15×2.23=0.33"				
27	**TOTAL LOSS** (MAIN)			1.67"		0.54"		0.99"				0.52"
28	TOTAL LOSS	1.76"	1.76"	3.43"	3.43"	3.97"	3.97"	4.96"				5.48"

Fig. 1. All original data are shown on the diagram proper. Air flows are those originally contemplated, and on which specifying of pipe sizes shown was based.

Lines 12-18—Comparing the loss in branches 1 and 2 (1.76 in. and 0.98 in. respectively) for the "standard" velocity, it is apparent that if the minimum of 3500 fpm is to be maintained in branch 1, the flow in branch 2 must be greater than 687 cfm (3500 fpm); great enough so that the loss in head is 1.76 in. The actual Q is readily calculated as shown (line 18, column 2), a calculation based on the elementary relation that Q varies with $\sqrt{h_L}$.

Line 22—Air flow in the main is the sum of the previously determined air flows.

Line 23—Main pipe sizes are given in the original data of this problem, and were based on the principle that areas of mains should be approximately equal to the sum of the areas of all preceding branches.

Line 24—Main velocity follows from the air flow and pipe size.

Line 25—Friction loss from a chart, as in line 7.

Line 26—This tee-loss in the main results from turbulence caused by branch air stream entering main. It varies somewhat with the relative air volumes in main and branch. (See Alden, pp. 102-3.)

Line 28—This is the sum of the loss in the section of main to a point just beyond the taper, at the beginning of the next section of main, plus that previously calculated at a corresponding point up-stream. Thus each section of main includes also the tee at the downstream branch.

Branch 5—The treatment of sub-mains and sub-branches is illustrated at this point.

Air Flows in Unbalanced System

We may now compare the originally planned Q of line 2 (or line 4) with that which will actually flow through each branch, line 20, and note the magnitude of the discrepancy in this, a typical unbalanced system.

It is apparent that if, in overlooking these important distribution factors, the designer were to assume that a velocity of 3500 fpm *in the final section of main* would provide adequate velocities and air flows in all branches, he would obtain some velocities very much below the value specified. For example, in branch 1, the velocity would be only

$$\frac{3500}{5070} \times 3500, \text{ or } 2420 \text{ fpm}$$

Actually we find it necessary to maintain a velocity of 5070 fpm in the final main in order to satisfy minimum specifications in all branches. We note also that, whereas the total of air flows planned in the branches is about 6000 cfm, it is necessary to exhaust more than 10,000 cfm, the fan static pressure being 5.48 in. with 9 air horsepower required. We shall later compare these figures with those of a carefully designed system.

Transporting Velocities

Although the term "transporting velocity" has a definite and obvious meaning, it is often mistakenly identified with the "average system velocity"; that is, the velocity that is maintained in the last section of main pipe in an unbalanced system, as in the example just studied. As we have seen, the average system velocity is not a fundamental, but is dependent on the particular combination of branches and mains.

Thus it is clear that the magnitude of transporting velocities, methods of estimating them and their application to practical problems is an academic question unless considered in conjunction with the factors of balance or unbalance in an exhaust system.

Many designers will insist that velocities of 4000-4500 fpm should be provided for most dust exhaust systems and will cite experiences to support their contention and these for dusts where it is a demonstrable fact that velocities of 2500-3000 fpm will transport them adequately. The contradiction, however, is only an apparent one, for the reference in the first case is to "average system velocity" for the typical unbalanced system, whereas the latter figure refers to the true transporting velocity.

Designing a Balanced Exhaust System

In the following section we shall consider the same exhaust system as in example 1, wherein, as an unbalanced system, the actual air flows in various branches were calculated and compared with those intended. In the present treatment, however, we shall correct pipe sizes to effect greater friction losses in certain branches where necessary to avoid excessive air flows and power consumption. We will then have designed a balanced exhaust system.

The purpose of this discussion is not so much to emphasize the well known fact that such balance can be attained as to demonstrate the simplicity of the following method. As will be seen, one of the main features of the method, tabular arrangement of all calculations, has already been demonstrated in example 1.

Design Specifications

The pipe layout for this exhaust system is the same as in the previous example, and is illustrated in Fig. 2. The design specifications for this particular problem are tabulated below and are to be realized without the use of restrictions in branches.

(a) Velocities in branches: Not less than 3500 fpm (approx.).

(b) Velocities in mains: Between 3000-3500 fpm.

(Note: In this example, 3000 fpm is taken as the minimum transporting velocity. However, it is convenient to specify a permissible *range* of velocities in mains, as will be apparent later, and in branches a somewhat higher velocity permits some flexibility in computations. In any case, this particular choice of velocities is without significance in the present demonstration.)

(c) Air flows: Not less than those specified (see Line 2), nor greatly in excess, except where deliberately increased in a branch to save power for the total system.

Considering first branch 1 (column 1), note the procedure indicated therein.

Explanatory Notes

Line 4—In line 3 a pipe size was selected that comes *nearest* to giving the standard velocity of 3500 fpm with the preliminary air flow of Line 2. At this stage, recognizing that pipe sizes would not be specified in closer than ½ in. intervals, we calculate the exact air flow still to maintain our standard velocity of 3500 fpm.

Lines 5-11—As in the previous example the total friction loss for each branch is calculated from its elements for the standard velocity, 3500 fpm in the present case. The total written on line 11 is the loss corresponding to the standard velocity (and air volume).

Lines 12-20 (Columns 1-2-1′)—Having computed branch losses for both branches 1 and 2, a comparison of the two values will indicate the propriety of the following steps in the design.

Branch 1 accounts for a relatively minor fraction of the total air flow of the system, yet to maintain this minimum air flow (300 cfm), a pressure loss of 1.76 in. is needed, compared with only 1.00 in. for the requirements of branch 2. All subsequent branches are affected by the resistance at this point and it is clearly advantageous to decrease resistance through this branch. This can be done only by increasing the pipe size while maintaining the minimum velocity. Although the change will be wasteful for this particular branch, the increase in air flow relative to the entire system will be small and power will be saved.

As an approximation an increase in pipe diameter from 4 in. to 6 in. is indicated, this decision being arrived at by inspection.

The result, column 1′, is satisfactory and indicates a saving in system resistance of nearly ½ in. Final adjustment is now made for branch 2 in lines 18 and 20. (Note—In this particular example the power saving will be insignificantly small but the principle is effectively illustrated. The very nature of the problem does not warrant closer estimation of the appropriate change in pipe size.)

Lines 22-27, Main A—Having obtained Q as 1487 cfm, the proper pipe diameter to give the specified velocity (3000-3500 fpm) is selected and pressure loss in the main determined and added to the previous total. In each such calculation the tee loss in the main (line 26) is included to bring the calculation to an end point just slightly downstream from the junction with the following branch (marked with an "x" on the piping diagram).

Lines 11-20, Branch 3—The loss in this branch (1.56 in.) at the standard velocity is not as great as that in the main (1.94 in.), hence, in order to avoid the wasteful increase in Q that occurred under the conditions of example 1 we must increase the resistance of this branch by decreasing pipe diameter if practicable.

To determine the practicability, and not decrease air flow below the specified minimum, a method of trial and error is simplest. In order, however, to restrict our paper work to a single trial we have recourse to the following simple device set forth in the following digression.

5th Power Chart

It can easily be shown from the fundamental formula for friction loss in pipes that the loss in a given length of duct varies as the fifth power of the diameter if the rate of air flow through the different pipe sizes considered is maintained constant. The chart of Fig. 3 is based on this relationship and may be used as follows, in the problem at hand, namely:

What will be the pressure loss in branch 3 (now 1.56 in. when carrying 1220 cfm through an 8 in. pipe) if the pipe were reduced to 7 in. diameter with the same air flow. The chart shows us that pipe friction will be increased about 1.95 times its present value which is much more than wanted. A reduction from 8 to 7½ in. (same as 16 to 15 in.) would increase pipe friction 1.4 times, which is not far from our objective.

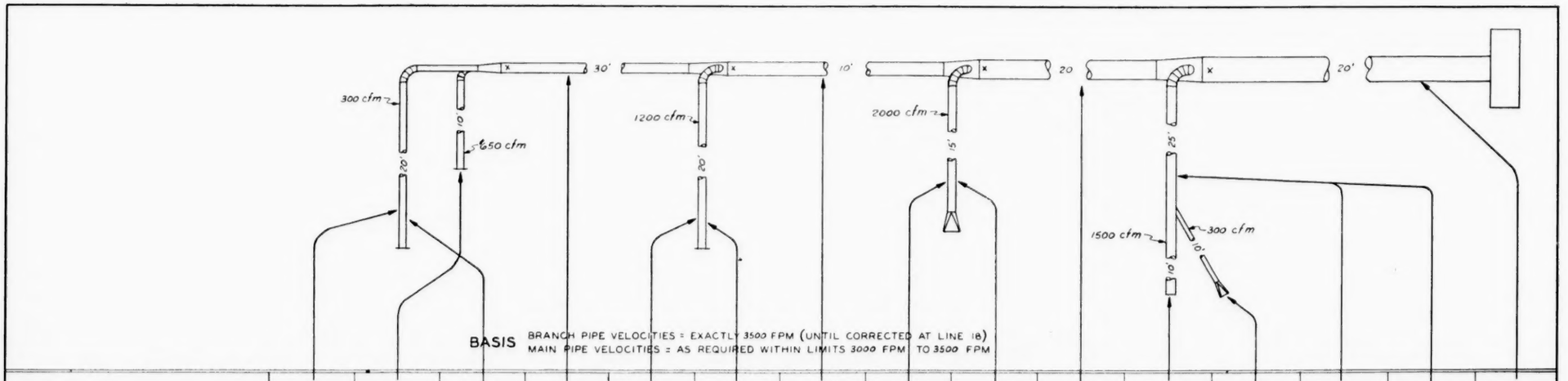
Actually our branch losses are composed of shock losses as well as pipe friction, and such losses vary as the fourth power of the diameter ratio, at constant air flow. Hence, when the resistance is considered in branches wherein shock losses are an appreciable proportion of the total, pressure losses vary as the diameter ratio raised to a power that lies between 4 and 5. Nevertheless, the 5th power chart is a good enough approximation for our purposes.

Returning to the problem, it is seen that a reduction in the size of branch 3 from 8 to 7½ in. will increase the loss to something less than $1.4 \times 1.5 = 2.2$ in. Since we have 1.94 in. in the main to be met it appears that the proposed change will probably satisfy the conditions.

The summary of losses accordingly calculated for a 7½ in. pipe indicate this to be sufficiently close. Actually an air flow of 1185 cfm will result.

(Note—In practice one would leave the branch at 8 in., to exhaust $1220 \sqrt{\frac{1.94}{1.56}} = 1360$ cfm. For the purposes of our demonstration, however, we are splitting hairs, and hence select the 7½ in. pipe.)

Columns 4, 4′—A similar situation is encountered with branch 4 wherein it is found that friction loss (0.78 in.) at the standard velocity is so much less than that prevailing in the main (2.18 in.) that a large and uneconomical increase in air flow through this branch above that originally considered necessary would result. The friction must be therefore materially increased by a reduction in pipe diameter. Reference to the 5th power chart indicates that a decrease from 10 in. to 8 in. (same as 5 in. to 4 in.), for the same air flow, would increase friction loss approximately 3 times to around 2.4 in. (0.78 in. × 3). This is close enough to the main suction (2.18 in.) to warrant the recalculation in column 4′. The result (2.25 in.) indicates the choice to be a wise one and that the air flow will be only slightly less than 2000 cfm (line 18-20).



1 BRANCH OR MAIN	1	2	1'	Main A	3	3'	Main B	4	4'	Main C	5a	5b	5	5'	Main D
2 PRELIMINARY Q (CFM)	300 cfm	650 cfm			1200 cfm			2000 cfm			1500 cfm	300 cfm			
3 NEAREST PIPE DIAMETER	4"	6"	6"		8"	$7\frac{1}{2}$"		10"	8"		9"	4"	10"	9"	
4 Q FOR CALCULATION 3500 cfm, h_v=20.76	306 cfm	687 cfm	687 cfm		1220 cfm	1200* cfm		1910 cfm	2000* cfm		1550 cfm	305 cfm	(5a+5b) 1884* cfm	1884* cfm	
5 BRANCH LOSS						*V=3910, h_v=0.96"			*V=5720, h_v=2.05				*V=3460, h_v=.79	*V=4270, h_v=1.14"	
6 HOOD ENTRANCE (Given)	0.5×0.76=0.38	0.5×0.76=0.38	0.5×0.76=0.38		1.0×0.76=0.76	1.0×0.96=0.96		0.25×0.76=0.19	0.25×2.05=0.51		1.0×0.76=0.76	0.25×0.76=0.19	(entrance loss in 5a and 5b) 1.08	(entrance loss in 5a and 5b) 1.08"	
7 BRANCH PIPE FRICTION (Data friction chart)	5.4×20/100=1.08	3.4×10/100=0.34	3.4×20/100=0.68		2.5×20/100=0.50	3.3×20/100=0.66		1.9×15/100=0.29	6.3×15/100=0.94		2.2×10/100=0.22	5.4×10/100=0.54	1.9×25/100=0.48	3.2×25/100=0.80"	
8 ELBOWS (17% velocity head / 90° L)	0.17×0.76=0.13	0.17×0.76=0.13	0.17×0.76=0.13		0.17×0.76=0.13	0.17×0.96=0.16		0.17×0.76=0.13	0.17×2.05=0.35				17×.76=.13	.17×1.14=0.19	
9 ENTRANCE TO MAIN (22% velocity head)	0.22×0.76=0.17	0.20×0.76=0.15 (tee loss)	0.22×0.76=0.17		0.22×0.76=0.17	0.22×0.96=0.21		0.22×0.76=0.17	0.22×2.05=0.45		0.13×0.76=0.10 (tee loss)	0.22×0.76=0.17	0.22×0.75=0.17	0.22×1.14=0.25	
10 OTHER															
11 TOTAL LOSS (BRANCH)	1.76"	1.00"	1.36"		1.56"	1.99"		0.78"	2.25"		1.08"	0.90"	1.86"	2.32"	
12 NEEDED MODIFICATION	Note that loss through branch 1 exceeds that in branch 2 by 3". This margin with saddle all * other branches with extra and unnecessary loss. Though Q in branch 1 is insignificantly small. Better to increase size of branch 1. Increase to 6" (same velocity)				The 5th power chart indicates that decreasing D to $7\frac{1}{2}$" would increase friction about 1.4 times to a little over .2" Decrease to 7½" Next Column	This loss practically equals that in the main (1.94") hence is satisfactory Insignificant decrease in air flow is indicated below.		If permitted to stand this low loss branch would exhaust $\sqrt{\frac{2.18}{0.78}}$ = 3200 cfm. Restriction is therefore necessary. 5th power chart indicates that reduction from 10" to 8" would increase loss approx. 3 times which looks about right, therefore recalculate (equation 4)	This loss quite closely approximates that in the main (2.18") The modification is therefore satisfactory Slight air flow correction below.		Being a sub-branch this is to be compared with branch 5b only. Q = 1550 cfm	Sufficiently close to that in branch 5a. Air flow correction below Q = 305 $\sqrt{\frac{1.08}{0.90}}$ = 334 cfm	Comparison with 2.46" in main indicates improvement possible by increased friction 5th power chart (1884 cfm) indicates that reduction from 10" to 9" for this section is desirable. See further discussion in text.	A satisfactory result, since loss now nearly equals the 2.46" existing in the main.	
13															
14															
15															
16															
17															
18 INCREASE / DECREASE Q TO EQUALIZE $\frac{Q_2}{Q_1}=\sqrt{\frac{h_2}{h_1}}$		Q=687 $\sqrt{\frac{1.36}{1.00}}$				Q=1200 $\sqrt{\frac{1.94}{1.99}}$			Q=2000 $\sqrt{\frac{2.18}{2.25}}$						Q=1884 $\sqrt{\frac{2.46}{2.32}}$	
19															
20 FINAL BRANCH Q		= 800 cfm	687 cfm			1185 cfm			= 1970 cfm		Q=1550 $\frac{1940}{1884}$ = 1596 cfm	Q=334 $\frac{1940}{1884}$ = 344 cfm	(To note extent of changed air flow in 2 branches (may be skipped))	1940 cfm	
21 MAIN															
22 Q (MAIN)				1487 cfm			2670 cfm			4640 cfm					6580 cfm
23 NEAREST PIPE DIAM.				$9\frac{1}{2}$"			$12\frac{1}{2}$"			$16\frac{1}{2}$"					20"
24 VELOCITY (MAIN)				3030 fpm (h_v=.057)			3130 fpm (h_v=.061)			3120 fpm (h_v=.61)					3020 fpm
25 FRICTION LOSS (MAIN)				1.55×80/100=0.47			1.2×10/100=0.12			0.89×20/100=0.18					0.68×40/100=0.27
26 TAPER-TEE LOSS (MAIN)				0.20×0.56=0.11			0.20×0.61=0.12			0.17×0.61=0.10					
27 TOTAL LOSS (MAIN)				0.58"			0.24"			0.28"					0.27"
28 TOTAL LOSS		1.36"	1.36"	1.94"		1.94"	2.18"			2.46"				2.46"	2.73"

Fig. 2. All original data included on the diagram proper.

Columns 5a, 5b, 5, 5'—The treatment of sub-branches is illustrated at this point as similar to that for regular branches. In calculation of the losses in section 5 downstream from the two sub-branches, the entrance loss is that through these two sub-branches (line 6, columns 5 and 5'). Note the advantage of the poor (high resistance) entrance hood of branch 5a in equalizing losses between branches 5a and 5b. A low resistance hood would have necessitated decreasing the diameter of the 9 in. pipe to increase resistance in order to more nearly approximate that in 5b. The reduction in pipe size from 10 in. to 9 in. is decided by means of the 5th power chart on the same basis as previously illustrated. Note, however, that the entrance loss, 1.08 in., is unaffected by the changed pipe diameter. Therefore, the reasoning is this: 10 in. — 9 in. reduction will increase resistance $1.7 \times (0.48 + 0.13 + 0.17) = 1.3$ in. making total loss into main of around 1.3 in. + 1.08 in. or 2.4 in. Since value in main is 2.46 in., this change is indicated, hence the recalculation in column 5'.

Lines 18-20, Column 5'—The increased air flow in branch 5 (includes 5a and 5b) which will occur in the final adjustment of balance (line 18) necessitates one more calculation of the air flows in 5a and 5b as indicated by the supplementary calculation (see directional arrows) at line 20, columns 5a and 5b. This step could be skipped unless one wished the final value of Q for these branches. Actually the change is insignificant in this example and is performed only because of the nature of this demonstration.

Significance of Balanced Flow Calculations

A comparison of the results of the two methods of designing the dust exhaust systems in examples 1 and 2 is striking. It demonstrates that the balanced exhaust system resulting from a systematic modification of branch pipe sizes requires only one-third as much power as the more wasteful unbalanced system, 2.8 air horsepower versus 9 air horsepower. Note that even in the balanced system the total air flow must be 10% more than the total of air flows planned.

It is well to be practical about this question of design methods in order not to be led to exaggerated conclusions as to its importance.

It is a fact that exhaust systems are very seldom designed for balance by systematic modification of branch pipe sizes and, furthermore, it is very common practice to approximate a planned result by application of "safety factors" or an "allowance for leakage" as it is sometimes called, the magnitude of such factors being determined by the judgment of the designer.

It can be argued that these methods, to a large extent hit-or-miss, can accomplish the desired result of avoiding dust settlement in pipes and so far as anyone knows a close approximation to the intended air flow.

It would be foolish indeed to indicate that a balanced exhaust system should be designed on a careful basis for every piddling dust exhaust system to be installed. More often than not the air flow specified for each branch is itself only an approximate estimate wherein the designer himself would readily concede that an air flow, say 50% greater in some branches, would be so much to the good and insure more certain control of the condition to be corrected.

Very seldom is there any check, after installation of an industrial exhaust system, of the power efficiency. This means that there is practically never any penalty suffered by the contractor for a wasteful exhaust system which nevertheless accomplishes its job of dust control satisfactorily. On the other hand, let such a newly installed system result in poor control of dust for whatever cause, and the contractor or whoever designed it is penalized in one way or another.

It is thus readily comprehensible that where a designer is uncertain of the propriety of his estimates of air flows necessary (and this is probably true in most cases where control of a health hazardous dust is concerned) the question of designing for a balanced sys-

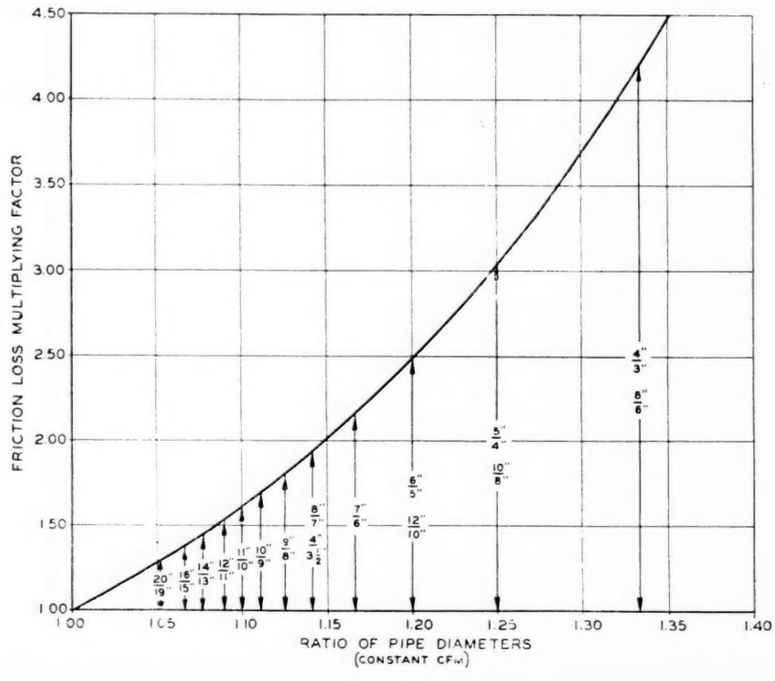


Fig. 3. Chart for estimating increased friction loss in a duct when diameter is reduced and air flow unchanged.

Example: Friction loss in a 5 in. duct will be 2½ times that in a 6 in. duct for the same flow. (Common pipe ratios are marked. Others may be found.)

tem which will limit air flows in all branches to those planned is a pointless one. We must understand, therefore, that improved design methods involve not only that aspect described in the present article but also more accurate methods of estimating required air flows through hoods for dust control.

The use of restrictions, usually blast gates, in branches to obtain balanced air flows is, of course, an available method for correcting gross unbalance in a finished system except where large quantities of abrasive dust are handled, or the material is fibrous, includes large heavy pieces like that in wood waste systems or because of extreme fineness is sticky like flour, lime and the like. Too often, however, blast gates are provided for the purpose but are not adjusted and locked in their proper position. This can be done best while measuring air flows through the hoods by means of a U-tube manometer. Unless the blast gates are adjusted with the aid of a manometer or other instrument, permanently and proof against tampering, the system is much better off without them.

What then is the practical value of such a design method as has been described for attaining balance in a dust exhaust system? If, as has been indicated, the designer seldom gets credit for an economical system, but is penalized for estimating air flow requirements too low; if we are to avoid hair splitting in recognizing the futility of applying these painstaking methods to every little dust system designed; if fixed blast gates are of practical use—if all these be largely true, why bother with calculations which involve a lot of additional paper work?

Value of Balanced Flow Calculations

It is perfectly obvious that the circumstances cited above constitute no valid argument whatever for avoiding a little extra mental effort, an effort that spells the difference between the tin-knocker and the engineer. Every engineer concerned with the layout of dust exhaust systems should apply such a method of calculation to enough of his jobs to become thoroughly acquainted with it, for by no other method will he so readily come to appreciate the significance of the various factors involved in such problems.

He will more thoroughly understand how it may happen that one dust system laid out in accordance with common principles includes a branch or two that causes constant trouble because of plugging with settled dust, whereas another system in which the same principles were applied is entirely free of such trouble.

He will comprehend the influence of the various factors that determine how much additional fan capacity is required in an unbalanced system beyond that indicated by the sum of the nominal capacities of the branches as planned.

He will recognize that a system with *adjustable* blast gates in branches (so that those not in use may be cut out) is *not* as a rule more economical of power because it must provide for much higher main pipe velocities than would otherwise be required. He will understand why, when some branches are cut off, the flow of air in remaining branches is not increased by the amount cut off—but that total air flow in the system is reduced. He may easily calculate the exact effect of so cutting off a branch in any given case.

He will appreciate that a 5-inch branch remote from the fan end of a system that includes many 7-8-9-inch branches is much more disadvantageous than the reverse; that great advantage results from combining small diameter branches with the shortest possible runs of pipe into larger diameter sub-mains or mains, arranging to have the longest runs of pipe of the larger diameters.

He will learn to avoid where possible combining small diameter branches in the same system with much larger diameter branches, e.g., 4 in. branches with 8 in. and 10 in. branches and can decide on an engineering basis when there should be two separate systems, combining small branches in one and large branches in another.

He will recognize the fallacy of specifying, with great care, hood forms (nozzles) having low friction losses, that is, high entry coefficients like bell-mouth nozzles for any branch except the key branch, usually the one most remote from the fan. Friction losses in that branch, it will be obvious, should be made as low as good hood design and piping arrangement can make it, but it is pointless to arrange for bell-mouth nozzles for other branches to reduce friction loss when in the same flourish it is necessary deliberately to increase friction losses in the pipe to restrict air flow to the desired value.

He will understand and can demonstrate mathematically the logic of the rule specified in some codes for exhaust systems that requires the area of a main pipe to be 20% greater than the sum of the areas of all preceding branch pipes; a simplified design procedure that tends to improve balance in air flows between branches by minimizing friction losses between branches (in the mains) and increasing it in branches. This code rule and that specifying a static suction of 2 in. at the hood were devised for application to exhaust systems for transport of nuisance dusts and waste material. Those rules are simple of administration and provide a design basis that will avoid clogging of dusts for insufficient velocity as well as tend to effect better distribution of air flow between various branches.

So familiar has this code become to sheet metal contractors that not infrequently they attempt to apply the same method of attack to exhaust systems other than those for control of nuisance dusts. Such abuses do not, of course, warrant condemnation of the original code and, in fact, many of the criticisms levelled at it would not be made by one thoroughly conversant with the aspects of design treated in this article. He will know *the virtues and the shortcomings* of these rules which unfortunately tend to handicap the few but aid the many concerned with exhaust system design for waste removal.

The engineer who applies the principles of balanced flow to his design problems will also by his more thorough familiarity with their many aspects be able to eliminate guesswork in trouble-shooting existing faulty systems or to determine to what extent additions may be made without serious impairment of an existing system.

Summer of 1941 Hotter than '40, Degree-Hour Data Show

Since the number of variables which affect the summer air conditioning load is high and since the dry-bulb temperature of the outside air is of much less importance among the other variables than it is in connection with winter heating, it is doubtful if any one single factor can be used to show load proportionality for different types of buildings in the summer as it can in winter with the degree day.

However, where there is little internal load, either sensible or latent, such as in residences, some such simple proportionality may exist. Research indicates that the load unit for residences for summer may be the summer degree hour above 85F.

*Maximum, minimum, and average seasonal totals of summer degree-hours are included in both tubular and map form in the Air-Conditioning Engineers' Atlas, by Strock and Hotchkiss. The Industrial Press, 148 Lafayette St., New York. Price, $2.

The figures below show the number of degree-hours for the past summer for a number of cities.* To obtain them, 85 was subtracted from the hourly temperatures for each hour it was over 85F, and the results totaled for the periods.

The first seven columns of figures are the degree-hours totaled for each of the summer months of 1941. The eighth and ninth columns show the total number of degree-hours experienced during the whole summer for both 1941 and 1940. The tenth and eleventh columns show the seasonal totals for each of the cities for the hottest and coolest summers of the past ten years.

Of the 32 cities listed, 26 showed a hotter summer this year than last, 3 indicated a milder summer this year than last, with insufficient data in 3 cities.

SUMMER DEGREE-HOURS (ABOVE 85F)*

SUMMER OF 1941†

City	April	May	June	July	August	Sept.	Oct.	Total, Apr. 1 to Oct. 31			
								1941	1940	Max. Yr.	Min. Yr.
Baltimore	78	400	385	654	555	374	248	2694	1606	2694	1080
Birmingham	0	336	513	520	405	537	173	2484	2247	3906	1841
Bismarck	0	123	243	1002	603	69	0	2040	1697	4633	1033
Boston	6	62	344	129	83	106	0	730	249	734	204
Buffalo	0	0	0	34	0	0	0	34	47	113	11
Chicago	0	60	278	407	288	47	0	1080	903	1797	337
Cincinnati	1	209	294	731	502	202	28	1967	1729	3937	705
Cleveland	0	23	368	620	191	64	2	1268	273	1268	142
Columbus	2	209	413	763	325	107	5	1824	1655	2797	854
Des Moines	0	64	330	1022	891	25	0	2332	2053	6560	1502
Detroit	0	69	299	515	235	81	0	1199	793	1879	340
Fort Wayne	0	71	255	676	413	141	0	1556	1076	2741	353
Houston	0	146	507	1126	1462	429	121	3791	3872	4570	2938
Indianapolis	0	226	434	1064	696	158	0	2578	2389	4432	672
Memphis	0	305	837	1361	1282	463	75	4323	1942	4722	1942
Milwaukee	0	16	186	342	139	24	0	707	525	1090	233
Minneapolis	0	21	145	737	368	11	0	1282	1116	3017	541
New Orleans	0	190	555	792	1188	447	234	3406	2294	3476	2087
New York	0	17	155	136	95	45	40	488	314	560	75
Oklahoma City	0	49	335	1819	1427	461	0	4091		No Data	
Philadelphia	41	157	316	299	244	165	118	1340	895	1340	577
Pittsburgh	0	36	150	306	51	43	7	593	453	1262	293
Portland, Ore.	0	21	74	682	140	0	0	917	519	917	183
Richmond, Va.	107	446	347	674	682	311	310	2877	1051	2877	943
Rochester, N. Y.	0	23	264	453	45	62	3	850		No Data	
St. Louis	10	190	729	1163	1291	206	10	3599	2549	8361	2285
San Diego	0	0	0	0	0	0	7	7	104	456	0
San Francisco	0	3	0	0	0	0	3	6	0	201	0
Savannah	28	363	519	825	1204	528	182	3649	2888	3649	2320
Syracuse	11	27	278	283	46	102	0	747		No Data	
Toledo	0	96	284	479	205	94	0	1158	714	2064	445
Washington	94	361	305	512	328	302	225	2127	1235	2127	1194

*Computed from data made available through the cooperation of the U. S. Weather Bureau.
†For some few cities the total includes a few degree-hours for March.

Temperature as a Health Factor in Air Conditioning

By F. W. HUTCHINSON†

The author discusses here the effect of extreme temperatures on health, with particular reference to industrial plants. He describes how the human body adjusts itself to changes in temperature by using engineering analogies. This part of the article tells an engineer why air conditioning is frequently necessary from a health standpoint and makes the subject more clear than would many laborious hours of reading books written in the almost un-understandable language of the medical profession.

THE effect of ambient air temperature as a factor in determining the well-being of man is important to the air conditioning engineer for many reasons. In industry the need for improved ventilation can only be evaluated in terms of the health hazard, and efficiency reduction, associated with the existing conditions; the engineer must therefore be able to estimate the extent to which extreme industrial temperatures may endanger the health and output of workmen and the extent to which air conditioning can be justified as a means of removing or reducing such hazards.

Industrial Air Conditioning

Industrial air conditioning is less amenable to direct and simple solution than is air conditioning of homes, offices, or stores. The latter systems have as a common objective the production of conditions corresponding to comfort and the solution requires, therefore, that the temperature be maintained at the optimum value corresponding to the activity of the occupants, and the state, or range, of outside conditions. Industrial air conditioning, however, is frequently justified only to the extent of reducing extremes to a condition at which the health hazard will no longer exist; discomfort may remain. In many installations, as, for example, in engine rooms or galleys of ships, the cost of comfort conditioning would be prohibitive and the problem facing the engineer is to select a design temperature which, though uncomfortable, will not constitute a danger to the health of the occupants.

Determining Limiting Air Temperatures

The determination of limiting temperatures beyond which there is a health hazard is entirely within the province of the medical profession. For reasons which will be discussed later, the establishment of a satisfactory heat balance at the body surface is not, of itself, assurance that hazardous internal physiological adjustments are unnecessary. Consequently the engineer should use design data on boundary conditions prescribed by the doctor. This paper presents data on limiting conditions as published in the medical literature and develops an analogy which may assist the engineer in visualizing the manner in which air temperature influences internal physiological conditions.

Ordinarily we think of ventilation air as a medium for carrying oxygen into the lungs, carbon dioxide out of the lungs and heat from all of the body surface. Actually, however, the oxygen is destined for internal body tissues, or organs, and from these same sources is released both the carbon dioxide and the heat. It is a kind of "aid to Russia" process in which materials are carried in shiploads to the external boundary at Vladivostok (just as batches of air are brought to the lung surface by respiration) while a presumably steady stream of materials then flows over a fixed rail route to the interior points of utilization at Kazan, Moscow, etc. (just as the oxygen is carried continuously from the lungs through the circulatory system to the internal tissues and organs). The analogy is crude, but valid in that it emphasizes a relationship which exists between the external purpose of air conditioning and the internal purpose of circulation.

Blood Stream Acts as A.C. System

In a sense the human circulatory equipment can be considered as nature's air conditioning system which operates in series with the ventilation provided exterior to the body. As with all systems which operate in series, synchronism is essential. In this case maintenance of normal physiological conditions requires the transfer at a steady rate of oxygen, carbon dioxide and heat to or from the body successively through the agency of the blood stream, the transfer surfaces of the body and the ambient air; any disturbance or change of conditions in the circulatory system, at the skin and lung surface, or in the state of the surrounding atmosphere will necessarily destroy equilibrium throughout the entire system. The following section reviews briefly the mechanism of circulation.

Air conditioning brings oxygen from the outside atmosphere into the enclosure from which it is drawn into the lungs. From the alveoli of the lungs the oxygen passes by diffusion into the blood stream in the capillaries. The blood carries the oxygen to the internal organs and deep tissues where it is released

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and utilized in a process that is approximately comparable to combustion. The "product of combustion," carbon dioxide, is then picked up by the blood and carried back to the lungs where it is released to the air and then removed from the enclosure by the air conditioning system. Meanwhile, the energy made available by the "combustion" process is in part realized as work, but is largely unavailable for this purpose and must therefore be dissipated from the body as waste heat. The blood carries this heat to the body surface where it is transferred by radiation, convection, and evaporation to the surrounding environment and, again, removed from the enclosure by the air conditioning system.

The concept of air and blood as similar working fluids which operate in series is advantageous to the air conditioning engineer for two reasons. First, it assists in visualizing the effect and importance of such atmospheric variables as temperature, humidity and air motion. Second, it brings out the operating limitations to which the circulatory system is subject; limitations which would seriously handicap the air conditioning engineer if they applied to ventilating systems.

In some respects, blood is a far more satisfactory working substance than is air. As a carrier of oxygen, blood functions somewhat as does steam when carrying heat. Steam has a relatively low specific heat and if its carrying capacity were limited to sensible heat its ability to transport large quantities of heat would be negligible. But because of its high latent heat, steam is capable of carrying a relatively enormous quantity of heat and discharging it at constant temperature during the condensation process. Similarly, blood is incapable of transporting any appreciable weight of dissolved oxygen. If the oxygen requirements of man were limited to the oxygen carried in solution by the blood there would be no possibility of continuing the active life which man, and the other large animals, now lead. But the blood actually transports one hundred times as much oxygen as can be dissolved in it. Hemoglobin combines reversibly with oxygen to form oxyhemoglobin and under normal conditions becomes 95% oxygen saturated in passing through the lungs. Thus hemoglobin provides the same extra capacity for oxygen that latent heat provides, in the case of water or a refrigerant, for heat. Of added importance is the fact that the affinity for oxygen varies inversely as the blood's acidity; thus in passing through the tissues the increasing percentage of dissolved carbon dioxide raises the acidity and effectively assists in "unloading" more oxygen. As a corollary, when the carbon dioxide is given up in the lungs the blood becomes more alkaline and it is able to pick up a greater weight of oxygen.

Heart Acts as Fan

The heart is comparable to the fan of a ventilation system, but its operating range is very much greater. Under normal conditions for a man at rest it circulates 0.14 cubic feet of blood per minute with an oxygen delivery of 0.006 cubic feet per minute; at times of stress, however, the circulation can increase, briefly, by over 600% and the total oxygen delivery by 1200%. In order for this increase to be possible it is obvious that a 100% increase is necessary in the oxygen delivery from each cubic foot of blood. But at this point the advantage of the circulatory system over the ventilating system ceases. The heart possesses an astounding flexibility of operating load, but this flexibility is subject entirely to the control of a single circulatory requirement—oxygen supply. Cardiac output is independent of the required rate of heat dissipation and therefore does not assist in adjusting internal conditions to meet changes in the ambient air temperature. The circulation rate is seemingly subject to control only by the body's mechanism of heat production and so long as the rate of heat production remains constant the circulation will not appreciably increase even though changing external conditions may seriously affect the ability of the body to adequately dispose of waste heat. The situation is comparable to that which would exist in an air conditioning system if the temperature of the conditioned air supplied to an occupied room was constant and the fan output was capable of 600% variation, but only in response to a change in the density of occupancy; thus the volume of air supplied would vary directly with the number of occupants, but would not be subject to change to meet the changing heat removal load which results from variation in the outdoor temperature. The "thermostat" controlling cardiac output responds to oxygen needs, but not to heat disposal requirements.

The above condition brings out the important fact that the two principal functions of the circulatory system — transportation of oxygen to the interior of the body and transportation of heat to the body's surface —are sometimes opposed to one another. The principal significance of air temperature as a health factor is now believed to derive from the indirect effect on oxygen supply resulting from circulatory adjustments required to meet changes in the heat transfer problem.

Since cardiac output does not vary with air temperature it is obvious that nature must provide some other method of realizing the internal adjustment which is needed in order to sustain constant body heat loss with varying external temperature. Such adjustment is largely accomplished by an automatic throttling action similar to damper control in an air conditioning system; although the volume of blood leaving the heart remains constant, the proportion which goes directly to the skin surfaces increases as a function of air temperature. In this way the skin temperature is raised and the temperature difference from skin to environment, which is a determining factor in radiant and convective heat transfer, is at least partially restored. This "skin effect" is not uniformly evidenced over the entire body area; some portions, notably the extremities, show a much more pronounced effect than does the trunk.

From this it follows that the body's ability to regulate its internal temperature is largely a function of the flexibility of the peripheral vascular systems. It is evident then that any physical condition which affects these systems will be of influence in determining the ability of an individual to resist temperature variations. The extent of individual differences due to age,

condition of the arteries with respect to flexibility, etc., may have an important bearing on the ability to withstand extreme temperatures or rapid changes of temperature.

The health significance of this "throttling" effect arises from the fact that it is arterial blood which is diverted to the skin where it gives up heat and then flows back to the right heart without having delivered oxygen to the internal organs or body tissues. The resulting anemia affects the performance of heart, stomach and other organs; the suggestion has been made that anemia of the brain, from this cause, may be responsible for the mental lassitude which accompanies hot weather. At high temperatures the reduction in quantity of blood available for the internal organs is very great and, if exposure to such conditions is prolonged, chronic ailments may result.

Heat Lowers Blood Pressure

Dr. McConnell has called attention to the reduction in blood pressure which accompanies exposure to atmospheric heat and cites the result of investigations among textile and tin plate workers. Weavers, exposed to wet bulb temperatures of 70F or over, had average blood pressure of 99 millimeters as compared with 155 millimeters for tin plate workers who were not subjected to wet bulb temperatures greater than 60F. This would be expected from engineering considerations since the blood volume is constant and the effect of increased circulation through small blood vessels near the surface would therefore be similar to the enlargement of a pipeline. The reduction in blood pressure occurs notwithstanding an increased pulse rate, but it is pulse rate rather than increased skin temperature which serves as the best criterion for estimating the physiological response to heat; when the pulse rate exceeds 135 the first symptoms of discomfort appear and when it reaches 160 the effects become severe and distressing. In this connection it is interesting to the engineer to note that the increased pulse rate, corresponding to a higher rpm of a fan, is due to a less efficient operating condition and is not accompanied by greater flow.

Effect of High Temperature and Labor

The effect of high temperature combined with labor is not thoroughly understood. Benedict and Parmenter have shown that during periods of violent exercise or hard work there is a lowering of skin temperatures even when there has been an increase of 500% in heat production. They attribute these alterations to adjustments which decrease the flow of blood by constricting the surface vessels in order to divert the blood back to the active muscles. Thus, for such working conditions, the function of the blood as a carrier of heat is in direct opposition to its function as a carrier of oxygen and there is grave danger of complete failure of the regulatory apparatus. The heated tissues require more oxygen at a time when the blood is unable to supply it. This condition is particularly dangerous in that it leads to the setting up of a vicious cycle — increased external temperature leads initially to a reactive increase in heart rate accompanied by increased skin temperature and heat production; this necessitates a further increase in cooling power and to accomplish this it again becomes necessary for the heart to bring more blood to the surface; heat production again increases, etc. In this respect exposure to cold is decidedly less serious than to heat, for with cold the physiological reactions are compensating and the changes are not progressive; thus, as external temperature decreases there is a reactive decrease in heart rate accompanied by a reduction in skin temperature which in turn tends to decrease the temperature difference and restore normal equilibrium.

The U. S. Public Health Service has prepared charts correlating high external temperatures with mortality, accident frequency and the toxic effect of drugs, and in each case a verdict unfavorable to high temperature has resulted. Industrial accidents are a minimum at 68F. Yaglou states that "More important than the acute effects are the chronic effects, manifesting themselves in increased morbidity and mortality and a lowered physical efficiency. . . . In the very hot and heavy industries such as iron and steel, sugar refining, deep mining and others, experience in this country and Great Britain shows the worst respiratory incidence and mortality next to that seen in workers exposed to silica dust."

Upper Limits for Continued Exposure

The upper temperature for continued exposure while doing light work appears to be between 85F at 100% relative humidity and 100F at 40% relative humidity. At higher temperatures serious discomfort and injury to health are probable. Moderate work at the above temperatures leads to an increase in body temperature amounting to approximately .4F per hour and an hourly increase in pulse rate of 10 beats per minute.

While light work is possible at 85F and 100% without serious health hazard, it is nontheless at the expense of a lower efficiency. Under these conditions physical output is reduced 25% or more from output at 70F and 50%. Likewise, it has been shown by Huntington that mental effectiveness decreases when the temperature exceeds the comfort range.

Summary

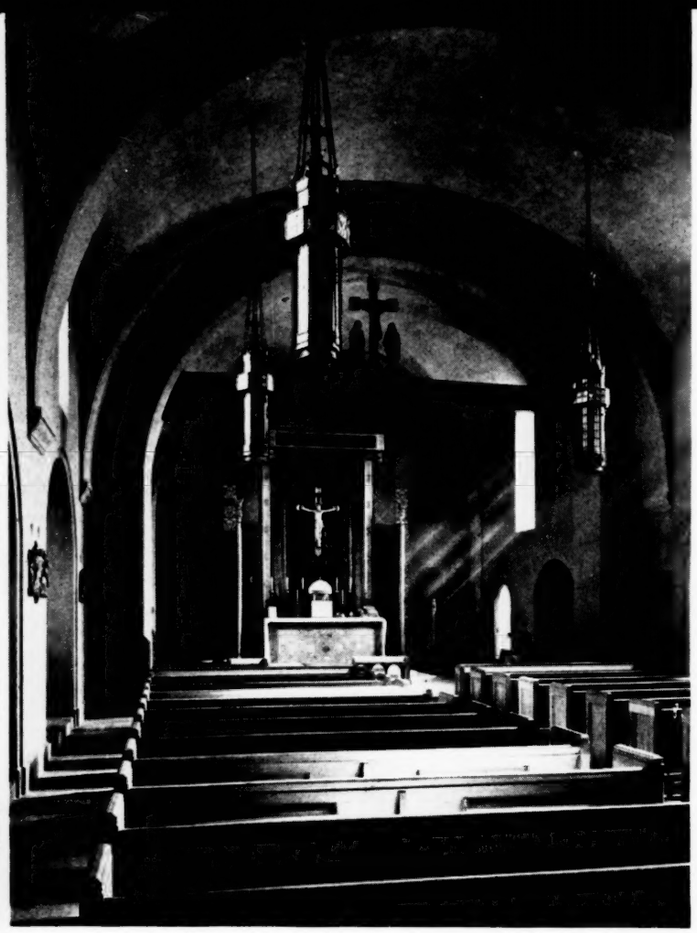
Summarizing, optimum environmental conditions exist at some air temperature lower than 75F, the exact value depending on the season, the outside temperature and the degree of activity of the occupants. As the dry bulb temperature rises above this optimum value physiological adjustment is possible without evidence of acute discomfort or danger to health until conditions equivalent to an effective temperature of 85F (as 85F, 100%; 90F, 70%; 95F, 50%; 100F, 40%) are reached. Above this effective temperature acute effects such as fever and rapid pulse, and chronic effects due to anemia of the vital organs, may lead to a serious impairment to health. For conditions of heavy work the critical temperature is below 85F and 100%.

Another article by Prof. Hutchinson will appear in an early issue.

Economical heating operation, carefully planned ventilation in

Cardinal Hayes Memorial High School

described by Edward J. Benesch†



The Chapel in the Cardinal Hayes High School. Bronx, New York. An exterior view of the school appears on the front cover of this issue.

AN edifice which would suitably honor the greatness of the beloved prelate Patrick Cardinal Hayes would be one incorporating all the skill, ingenuity of planning and construction techniques of the architects, engineers, and builders. The memorial finally selected was a high school for boys; one to fill widely diversified needs yet structurally of beauteous architecture and of ultra modern efficiency.

The inspiration conceived for the Cardinal Hayes Memorial High School for Boys is best described by the Very Reverend Philip J. Furlong at the dedication ceremonies. "Inspiration describes the manner of their achieving; for instance, inspiration can be found in this hall, unique in its loveliness, or in the gymnasium where you will find the manliness of young America expressed in brick and glass; or above in the room called 'library' that for all its efficiency has about it the atmosphere of home where a boy and a book may become fast friends; or in the laboratories where our boys will discover Nature's secrets and where they can explore the wonders of the physical universe; or in the heart of the building, the priests' chapel. . . ."

This inspiration became specific in the following form:

(a) Sixty-four classrooms, for instruction of 3000 boys containing special equipment for instruction in chemistry, physics, biology, music, drafting, and typing;

(b) a private locker for each student;

(c) an auditorium for 1200 persons in which might be conducted school assembly, elaborate theatrical productions, or religious ceremonies;

(d) two gymnasiums;

(e) facilities for feeding the entire student body in two hours;

(f) complete living quarters for 45 priests;

(g) a priests' chapel with 16 side altars and sacristy;

(h) a library to contain 28,500 volumes together with ample reading space;

(i) living quarters for thirteen Brothers, and

(j) administrative offices, elevators, heating plant, etc.

Eggers and Higgins, the architects, achieved the fulfillments of this inspiration in a structure of unusual form—a large quadrant of a circle between long straight bar forms. Almost devoid of any merely decorative features, the building nevertheless achieves a real beauty of mass and a refinement of proportions between inter-related elements. Walls of buff brick are trimmed with Indiana limestone. Window trim and the spandrels with separate windows in grouped vertical lines are painted gray-green. Main doorways and the surrounding trim are statuary bronze and a grill over the central entrance is of the same material. George A. Fuller Company fulfilled the architects' achievement in brick, stone, and steel.

The ten requirements created many mechanical problems for Syska and Hennessy, the consulting engineers. Extreme care and study were required that the mechanical work would be correlated so as not to deprecate the architects' achievement in any detail. Almirall and Company, Inc., the heating and ventilating contractors, performed their function of correlation with the engineers to achieve a mechanical plant in keeping with the architectural requirements of the structure.

The Building

The school is located on the Grand Concourse in the Bronx at the junction of two divisions of the New York Central Railroad. The building is five stories in height, with a cube of 3,700,000 cu ft arranged so that the central portion forms a quadrant from which wings are extended. In the basement are the gymnasiums which

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occupy a floor area of 9650 sq ft and have a gallery seating 335, plus folding bleachers for 250 additional persons. On the mezzanine are the main supply air fan room, cafeteria, kitchen, classrooms, and convent living quarters. The auditorium comprises the interior and central portion of the first, second and third floors while the exterior wings of these floors provide for classrooms, laboratories, halls, locker rooms and fan rooms. Similarly, the Chapel extends within the interior of the central first and second penthouse floors and is surrounded by the priests' quarters, including bedrooms, studies, lounge, refectory, and kitchen. The main exhaust fan rooms are located in the towers at the extremities of the quadrant.

Boiler Room

Steam for direct heating, heating stacks, domestic and kitchen hot water is furnished by three Pacific low pressure high leg compact type steel boilers having a total heating surface of 6429 sq ft, and fired by Todd fully automatic horizontal rotary oil burners designed for economical operation using No. 6 Bunker C fuel oil at 150% rating.

The boilers are connected in parallel to a 16 in. main steam header from which individual mains are extended for the direct heating system, heating stacks, and hot water heaters. Condensate is returned to the boilers through individual Hartford loop connections from a main return header. Individual Skidmore electric-driven duplex vacuum pumps for the heating system, the heating stacks, and hot water heaters discharge to the main return header. A 2-in. vacuum equalizer line has been provided between the main steam header and the heating system vacuum pumps.

Each boiler is set on its individual furnace base. These bases are constructed of 12 in. common brick laid in cement; all walls of the furnace are insulated with 2 in. Sil-o-cel; the rear wall is further insulated with 12 in. firebrick while the side walls are protected with 4½ in. firebrick. The bases are erected on a structural concrete slab made water tight with membrane waterproofing. To protect the waterproofing from excessive heat the furnace floor is provided with a 4 in. hollow tile air circulating space coated with 1 in. high temperature insulating cement and the secondary air passage formed by a checkerwork of 6 in. firebrick set on end and 2½ in. brick on top laid flat.

Gases of combustion are carried off through a common steel plate breeching, provided with Simplex barometric draft adjusters, and connected to a stack located within the building. The stack, which is free standing within a brick and terra-cotta enclosure, is 3 ft 6 in. wide by 6 ft long inside, approximately 120 ft high, and having a wall thickness of 9 in. firebrick through its entire height. A stainless steel weather cap free of the enclosure protects the air space between the stack and the enclosure from the elements. The stack also receives the products of combustion from a high temperature type incinerator of 450 lb per hr capacity burning half garbage and half rubbish as fuel.

Fuel oil is supplied from two 15,000-gallon steel tanks located within the building at the boiler room floor level. Separate individual oil pumps and submerged heaters are provided for each burner. Oil tank heating consists of boiler water circulated by means of electrically operated low head circulators connected to pipe coils in the bottom of each tank. Duplicate circulators are installed with properly by-passed connections to permit circulation of hot water at all times.

The fully automatic combination gas-electric ignition combustion system was provided to minimize boiler room labor. Ess Instrument Co. photo-electric-cell-operated smoke indicators and alarms have been installed to aid in maintaining combustion efficiency.

Each boiler is equipped with Minneapolis Honeywell safety controls, including a low water cut-off.

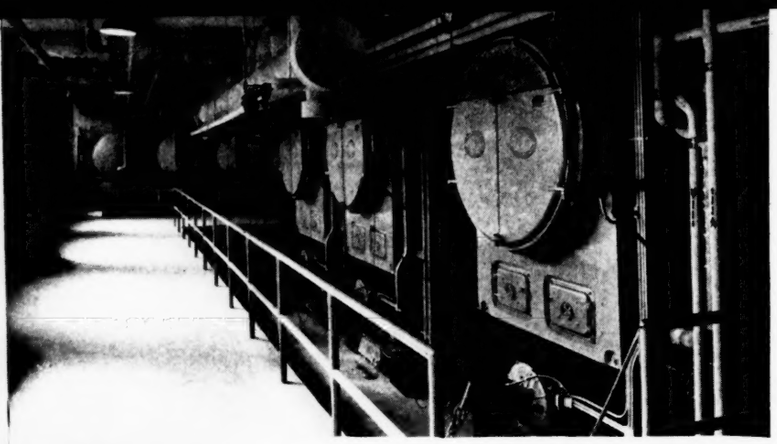
Boilers and vacuum pumps are located in a pit approximately 5 ft below the boiler room floor. The boiler pit, boiler furnaces, and stack have been so designed to permit installation of automatic stokers should this be deemed advisable at any time. Stokers would be of the hopper type, with coal supplied by means of a belt or screw conveyor from a bin located adjacent to and opening into the boiler room. Sidewalk chutes have been constructed to facilitate delivery of coal to the bin directly from trucks in case this change is ever made.

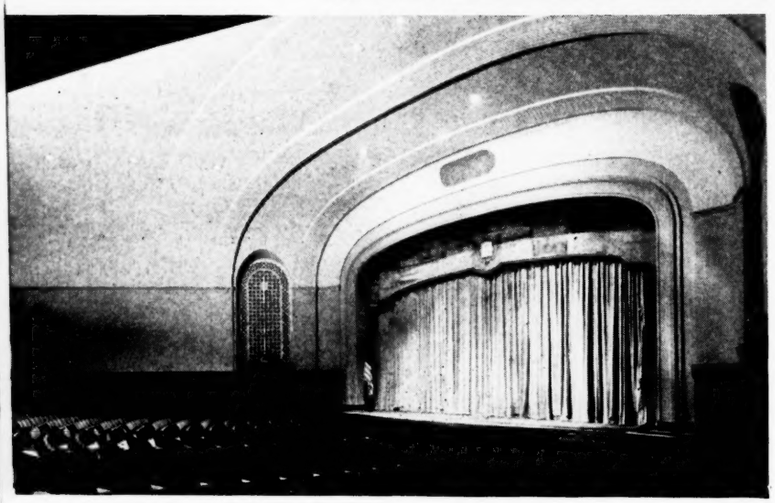
Air for combustion is furnished by means of louvered openings in the exterior wall of the boiler room. These openings connect with a hung ceiling space over the boiler room formed by the suspended plaster ceiling and insulated floor slab above. Ducts connected to this space are extended to near the boiler room floor so as to convey the air from outdoors to the boiler room. Under normal conditions of boiler operation air is drawn into the furnaces due to the draft created by combustion. The hung ceiling space is thereby ventilated preventing overheating of the floor slab above. However, operating conditions may be such that the air quantity would be insufficient to provide the required cooling of the floor slab. Under these conditions an independent exhaust fan has been installed in the boiler room to cause the required amount of air to be drawn through the hung ceiling space. To insure flexibility of operation the fan inlet has been provided with manually-operated regulating vanes.

Heating System

The heating system is of the two-pipe up-feed vacuum line type and except for the gymnasium, auditorium, and chapel the building is heated by National Radiator cast iron convectors with steel front enclosures fitted with Warren Webster Series 7 thermostatic return traps. In general, radiator connections have been extended within the convector enclosure from furred wall spaces above the floor. However, for the penthouse floors, structural conditions necessitated connections extended from the ceiling below or in some instances from branch steam mains.

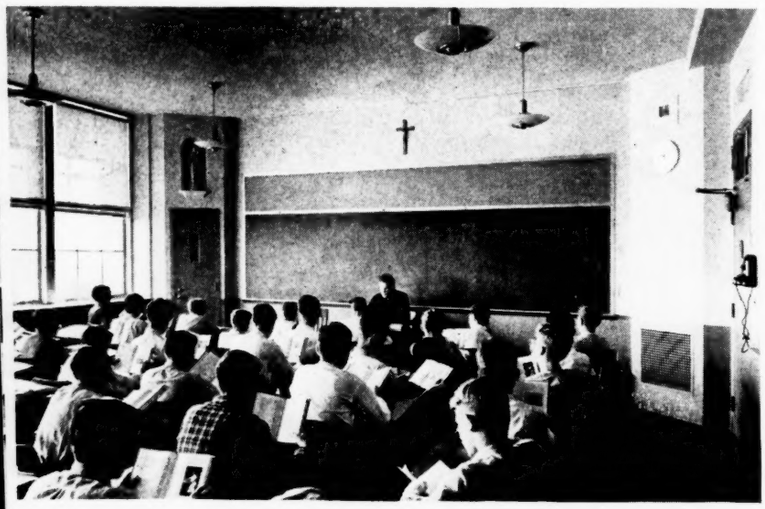
Due to the type of occupancy of the building, the amount of steam required for heating, from an economical standpoint of operation, is highly variable. Classrooms are occupied for only a certain portion of the day, whereas the living quarters—which occupy a considerable portion of the building—are continuously occupied. A combination of Johnson Service Co.





(Top) Boiler room showing the steel boilers used for the heating and water supply of the building. Hot water storage tanks and their circulating pumps are at the far end of the room. (Above) Auditorium and stage. Fully upholstered seats, carpeted aisles and duo-tone gold velvet curtains of the stage supplement the walnut wainscot and pastel gray-green walls and ceiling.

(Below) Typical classroom in the Cardinal Hayes High School, with grille at lower right. (Bottom) Business machines classroom in the School, with grilles above side blackboards.



pneumatic automatic temperature control, and Warren Webster Moderator temperature-economy control was adopted.

Each classroom convector has a pneumatically operated steam valve controlled from a thermostat located in the room. All radiators and convectors have been provided with orifice plates in the valve spud, or extended tube orifice in the convector inlet type. All radiators and convectors, including those in the classrooms, are indirectly under control of a master outdoor thermostat. The outdoor thermostat directly controls modulating steam valves in the mains furnishing steam to all radiators and convectors.

The classroom thermostats are of the day-night two temperature type. All thermostats are provided with a manual re-set and further controlled from a single central point. At the end of the school day all classroom thermostats are reset to a temperature 10 to 15F below "day" temperature. However, should an individual classroom require normal heating the particular thermostat may be reset to "day" temperature but must be restored to normal "night" setting manually. Meanwhile the remainder of the radiators and convectors are under control of the master outdoor thermostat.

Blast Heating

The Gymnasiums are heated by means of overheating the air provided for ventilation. The quantity of air supplied and exhausted from the rooms was determined by the number of occupants. Exposed walls and glass and a floor laid on strips slightly above the ground were the main sources of heat losses. A portion of the air discharged from the exhaust fans is diverted to the space under the gym floor and vented directly to outdoors. A manually operated adjustable bypass is provided between the exhaust fan discharge and the supply fan intake to provide rapid heating prior to occupancy. Temperature of supply air is directly controlled from a gradual acting thermostat located in the gymnasium which actuates the modulating control steam valves of the heating stacks. A low limit thermostat is provided in the supply fan discharge to prevent underheating of the spaces. Heated air is delivered to the spaces by means of Anemostats located in the ceiling and grilles located in the window sills; air is exhausted from ceiling registers located over the spectators' stand, near the gymnasium floor, and from the stepped floor of the spectators' stand.

Heating of the Auditorium was a lesser problem due to a minimum of heat losses. However, a system of indirect heating similar to that described for the gymnasiums was provided except for the omission of the recirculating system for rapid heating.

The Chapel was treated similarly to the gymnasiums since the heat losses were relatively greater than that for the auditorium. However, due to the architectural features the system was reversed. The center of the chapel space contains the pews, the sanctuary and sacristy while the perimeter of the chapel is occupied by practice altar spaces and confessional booths. Windows are high, tall and narrow. Heated air is supplied in the chapel from outlets located over the confessional

booths and exhausted from under the pews and from grilles located in the window sill. The system of automatic temperature control and recirculation is similar to that for the gymnasiums.

Ventilating Systems

Thirty-eight ventilating systems consisting of seventeen supply systems totaling 148,000 cfm and 21 exhaust systems handling 140,000 cfm are provided. The 38 systems are arranged as follows:

9	Classroom—Supply	75,000 cfm
9	Student Locker—Exhaust	58,700 cfm
1	Gymnasium Locker—Exhaust	10,400 cfm
1	Gymnasium Locker—Supply	10,600 cfm
2	Gymnasiums—Supply	17,000 cfm
2	Gymnasiums—Exhaust	15,000 cfm
1	Mezzanine—Supply	6,000 cfm
1	Auditorium—Supply	17,450 cfm
1	Auditorium—Exhaust	14,100 cfm
1	Convent—Supply	4,850 cfm
1	Convent—Exhaust	3,000 cfm
1	Toilet—Exhaust	9,450 cfm
1	Kitchen—Exhaust	11,000 cfm
1	Cafeteria—Supply	11,500 cfm
1	Cafeteria—Exhaust	10,600 cfm
1	Chapel—Supply	5,500 cfm
1	Chapel—Exhaust	4,100 cfm
1	Priests and Convent Kitchen—Exhaust	2,200 cfm
1	Projection Room—Exhaust	250 cfm
1	Boiler Room—Exhaust	10,000 cfm

All fans are of Sturtevant "Multivane," full housed, belt-connected to electrodynamic constant speed squirrel cage motors provided with Monitor Controller starters.

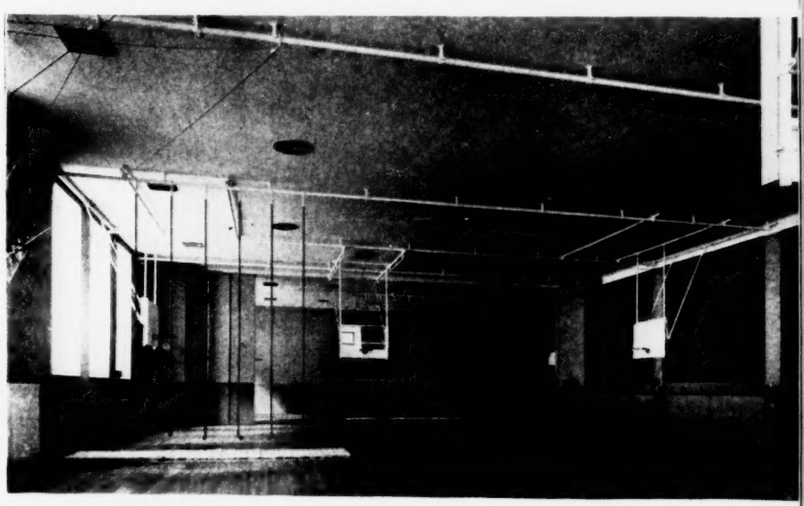
Utilization of the building for maximum scholastic purposes created a condition of minimum duct shaft space. To accommodate the ventilating systems an interesting arrangement of fresh air intakes, exhaust discharges and fan rooms was devised.

The fan room for the ventilation of the lower levels (consisting of the gymnasiums, cafeteria, kitchen supply, and convent, also a portion of the first floor classrooms and the auditorium exhaust systems) is located at the interior of the basement mezzanine floor. Thirteen fans are arranged in this room. Fresh air for the seven supply fans is supplied from areaways located at the front of the building, extended on the ceiling in two 132 in. x 42 in. reinforced 12 gauge steel ducts to a central fresh air intake plenum to which the fans connect. The exhaust fans discharge downward into a masonry tunnel which extends to the rear exterior wall of the building; automatic discharge back draft dampers are installed to prevent any air being supplied through the exhaust systems when the fans are not in operation.

Fresh air for the first, second and third floor central supply fans is obtained from louvers set in the insulated attic space on the fifth floor, the attic space serving as air intake plenum. Ducts are extended from the floor of the plenum to each fan room.

The supply fans for the westerly portion of the first, second and third floor classrooms receive fresh air from intake louvers set in the tower wall, while those for the northerly portion are connected to an areaway located

(Top) Cafeteria kitchen is designed for an ultimate capacity of 3000 students. Grilles shown at upper center. (Above) Cafeteria, with structural columns faced with mirrors, giving illusion of unbroken spaciousness. Tables are of Swedish iron standards with linoleum tops in sky-blue. Chairs are walnut finish. Seating capacity 750. (Below) Main gymnasium looking toward auxiliary gym, showing folding partition which when closed enables the larger and smaller gymnasiums to function independently. (Bottom) Typical Locker Room opening off corridor easily accessible by classes but because of their detached locations have made it possible to provide spacious classrooms. Note text regarding ventilation.



at the front of the building.

Except for the six exhaust fans in the mezzanine fan room all other exhaust fans discharge at the tower roof. The towers are approximately 150 ft apart. Kitchen and toilet exhaust fans are in the north tower fan room as remote as possible from the fresh air intake louvers in the wall of the west tower. Consequently, the necessity is seen for the location of the fresh air intake for the northerly classrooms in the areaway.

All supply fan intakes and exhaust fan discharges are provided with pneumatically-operated automatic dampers arranged to close when the fan is not in operation.

Filters of the American Air Filter renewable paper filter medium type are furnished at each supply fan intake. An inclined differential draft gauge is installed for each filter bank to indirectly indicate the condition of the filtering medium.

Heating stacks are of the Aerofin non-freeze type with the steam supply, in general, being controlled from pneumatic adjustable preset low limit duct type thermostats. In order to attain effective control of the discharge air temperature two control valves were arranged in parallel to govern the steam supply to the heating stacks.

Classroom Ventilation

Sixty-four classrooms are located in three floors along the perimeter of the building. Each classroom has a capacity of 44 students and instructor.

A unique feature of the ventilating systems is that provided for these classrooms. It is common knowledge that in any high school having the departmental system hallways are essential to permit the entire student body to pass from class to class. Similarly locker facilities are required and it is usual practice to locate the locker rooms adjacent to the halls. Space conditions and a limited budget required ventilating systems of minimum ductwork. The quantity of classroom ventilation is determined by good practice and the minimum fixed by law. Long interior halls and locker rooms require adequate ventilation.

A study of the plans indicated that the air exhausted from the classrooms could be supplied to the halls and the air from the halls exhausted through the locker rooms.

Each classroom floor contains three fan rooms, one room located at each extremity of the quadrant and a third at the center of the quadrant. In each fan room a supply fan furnishes fresh air to approximately one-third the total number of rooms. Air is distributed by a trunk duct located in the hall suspended ceiling space. Each classroom is provided with two Tuttle & Bailey air conditioning narrow vane type grilles over the entrance doors. Vanes of the grilles are arranged for fixed lateral deflection. Adjustable vertical vanes are provided behind the face vanes to permit horizontal deflection. Grilles are tapped square and full size into the side of the trunk duct. Volume control is attained by means of an adjustable felt-edged throat damper. Typically 1000 cfm is supplied to each classroom.

In each front corner of the classrooms a furred diagonal corner space has been provided. The furred space at the exterior wall forms a closet while that at the interior corner adjacent to the hall is utilized as an exhaust shaft and connection between the room and the hall. Complete exhaust registers are located near the floor of the classroom and similar registers provided near the ceiling of the hall. Thus the air is exhausted from the classroom near the floor and supplied to the hall near the ceiling.

In general, each classroom floor has two locker rooms. The locker rooms are actually alcoves off the halls. Lockers have been designed so as to permit air to be supplied to its interior. Groups of lockers are connected together and so constructed as to provide a plenum space to which each locker is connected. Each group, in turn, is solidly connected to ductwork extended to the exhaust fan inlet. In this manner a fixed positive quantity of air is drawn through the contents of each locker making for a sanitary installation.

The halls are of such length that fire walls and doors were provided at definite locations. Since these doors are required to be maintained in this closed position, the air supply to the lockers would be minimized to such an extent to prevent the required air flow through the lockers. To overcome this condition ceiling grilles were furnished at each side of the fire walls. These grilles were connected by 10 gauge steel ducts and at the point of penetration of the wall fusible link fire dampers installed. Access to the fusible link is attained through the ceiling grille.

Thus it can be seen that only one supply and exhaust fan accomplishes a triple utilization, namely ventilation of classrooms, hall and locker room.

The Cafeteria and Kitchen ventilation systems were also arranged in combination. Fresh air for the cafeteria is introduced into the space through Anemostats located to harmonize with the lighting fixtures. Air is exhausted from the cafeteria from over the serving counter by the exhaust fan, the discharge of the exhaust fan being connected to distributing ductwork to supply air to the kitchen. Air from the kitchen is discharged at the tower roof, the fan being located in the tower.

The ventilation of the Auditorium is arranged so that fresh air is supplied both under and above the balcony; air is exhausted over the balcony and at the floor. Direct connections are made to spot light boxes from which a generous amount of air is exhausted.

Except for the boiler room exhaust all fans are remotely controlled and except for the projection booth exhaust and boiler room exhaust fans all fans may be operated from a control board located in the mezzanine fan room. Each fan is provided with a push button start and stop station and an indicating pilot lamp. Push button stations are arranged on the control board so that the supply fan and its corresponding exhaust fan are adjacent.

Architects: Eggers and Higgins, New York.
Consulting Engineers: Syska & Hennessy, New York.

12-Year Old Ventilating Problem Solved

WHEN the Northwestern National Life Insurance Co. building was completed in Milwaukee in 1928 it represented the best known practice in architecture and mechanical engineering. The finest materials available for a structure of this type were used and the building was designed for lasting utility and beauty.

On the first floor of the building a force of 60 people is employed in clerical, supervisory, and executive capacities. Large glass areas in the outside walls of a single high ceilinged room admit light to the outside bays, but artificial lighting is required much of the time. Large filing cabinets serve as partitions throughout the room.

In addition to the sun load on the high windows, which is heavy in the mornings, indirect lighting fixtures account for a high proportion of the internal heat load. Lighting is provided by 120 single fixtures, each equipped with one 300-watt bulb, a heat gain of 122,796 Btu. People working in the room account for some 24,000 Btu, making a total of 146,796 Btu—not including solar heat and infiltration gain.

To offset this condition, in the fall, winter, and spring months at least, the designers installed an 18,000 cfm ventilating system using 100% fresh air. Providing about 300 cfm per person for those working in the room, the system was more than adequate for the purpose. Outside air entering the system is tempered, as required, by steam heated blast radiation located in a plenum chamber adjacent to the fan.

The tempered fresh air was introduced to the room through 36 plain lattice grilles located in the outside walls and in the faces of interior columns. These measure 18 x 18 inches, and have about 50% free area. The only control of air going to the grilles, which were mounted about 6 ft 6 in. from the floor, was the dampers in the riser ducts leading to the grilles. Following complaints of employees working near the grilles, air velocities were reduced by slowing down the fan, and in a number of cases the riser dampers were closed entirely.

This was not a satisfactory solution. Edward J. Wentz, building engineer, who has been operating the ventilating system for a number of years, reported that while fresh air was badly needed in the large room to offset the heat load, the system could only be operated at about 25% of capacity because of complaints from drafts. Some of the grilles were shut off entirely, others were partially covered with cardboard, and still the results were far from satisfactory to people working in the room.

N. O. McCormick sets outlet velocity at 900 cfm on Anemostat installed in wall.

When N. O. McCormick of the Downey Heating Co., Milwaukee, was consulted by the building owner, he made a careful study of the situation, and finally recommended that the lattice grilles be replaced with side wall diffusers, so that any quantity of fresh air could be introduced to the room without drafts. Anemostats were installed in conformance with the recommendations.

Duct outlets were changed to 11 in. x 27 in. to accommodate the throat measurements of the diffusers, and all dampers were removed from the riser ducts. Deflectors located behind the semi-circular cones on the diffusers made it possible to locate the outside wall units in pairs, and direct the flow of air outward as well as upward.

Now the incoming air is deflected in a series of planes over the heads of employees working in the room, and incoming fresh air is mixed with room air to reduce the temperature differences between floor and ceiling. Outlet volumes have been raised from 250 cfm to 900 cfm, permitting the ventilating system to operate at 100% of its normal capacity.—*Edmund W. Gifford, Milwaukee Manager, Himelblau, Byfield & Co.*

Low Air Pressure Kills Flowers

Flowers have been riding in airplanes for a long time but a new problem has arisen in connection with their transportation since the introduction of the stratosphere planes. An investigation of the effect of altitude on flowers has been under way by United Air Lines, Railway Express Agency, and the Department of Agriculture. One of the problems was to determine how to pack the flowers since it has been found that the cells of the flowers break apart under very low air pressures, causing them to lose color and stamina.

PROFITS IN AIR

DOUGLAS AIRCRAFT CO., INC.

AIR CONDITIONING FOR DEFENSE

builds windowless factory at Long Beach which features West Coast's largest air conditioning system using over 4000 tons of refrigeration in 68 separate systems. There are 23 individual boiler rooms supplying steam for heating purposes.

TWENTY-THREE individual boiler rooms housing the 23 boilers of a steam heating system with a total of 254,540 sq ft E.D.R., and 68 separate air conditioning plants with a total of 4,026 tons of refrigeration are used in the elaborate decentralized air handling systems, costing well over a million dollars, in the new $12,000,000 blackout factory of the Douglas Aircraft Co., Inc., at Long Beach, Calif.

The huge plant occupies a 200-acre tract adjoining the Long Beach Municipal Airport at the intersection of Lakewood and Carson Blvds. It contains 1,218,000 sq ft of production area in four manufacturing buildings and two storage and receiving units; 114,350 sq ft of floor area for office and personnel activities in three other buildings; and additional space in a paint storage building and a garage to bring the grand total to approximately 1,400,000 sq ft of floor area in the 11 buildings which constituted the plant as of mid-August.

When production of airplane parts and subassemblies got underway in early summer, some 3000 men and women were already at work, with employment rapidly accelerating toward the expected peak of 30,000 skilled workers, who will keep heavy bombers, transports and attack bombers rolling off the line night and day.

Its assembly lines mechanized and streamlined, the plant incorporates the latest in defensive arrangements, construction techniques and production systems.

The entire plant, including heating, ventilating and air cooling systems, was designed to make it as safe from bombing attacks as modern engineering ingenuity could contrive. Keynote of the design is decentralization. This includes decentralization of the manufacturing, storage and administrative activities, which are housed in eleven widely separated structures; decentralization of heating, since steam is generated in more than a score of boiler rooms; and decentralization of the air conditioning, composed of 68 separate systems.

The object of this decentralization is to avoid dependence of the entire factory on one central heating and cooling system. One, two or more of the buildings may be thrown out of action without interfering with the functioning of the others. The main buildings are separated from one another by open areas ranging from 75 to 150 ft. Purpose of this arrangement is to minimize the hazard of damage to one building affecting its neighbors.

The second feature of the design is the elaborate *blackout* arrangement. The buildings are completely windowless, lacking even skylights. Light traps are provided at all entrances to complete the blackout and render the plant invisible from the air at night and nearly so from but a few yards away on the ground. Double light-proof doors protect the openings through which railroad cars enter the buildings. Although no special stand-by power plant was regarded necessary (power is obtained from three high-voltage transmission lines at the factory site), transformers of the major power units are housed in underground concrete vaults. Oil and gasoline supplies are similarly protected.

To make the buildings less visible by day, the roofs are flat-topped, offer no light reflecting surfaces and are colored to match the district's special paving and to blend into the landscape. Trees and shrubs which have been planted along the walls will, when they attain full growth, blend into the factory's color scheme and contribute further to the camouflage, as will also the black exteriors of the buildings—another factor in assuring a complete blackout.

Heating is provided in all eleven buildings, air cooling conditioning in eight. Eight buildings have zoned heating as well as cooling, accomplished through varying numbers of air conditioning units in the different buildings. The number of units depends upon the size of the respective buildings and on the type of work

HOW INDUSTRIAL PLANTS PROMOTE PROCESSES AND PROFITS BY SCIENTIFIC CONTROL OF ATMOSPHERIC CONDITIONS

performed. Two of the largest factories, each of which is 300 x 900 ft, with 270,000 sq ft of floor area and a cubical content of 9,450,000 cu ft, have 15 refrigeration units, three boiler plants and 15 fan stations.

Main buildings with zoned heating and cooling arrangements are the following:

Administration, Personnel, and Cafeteria buildings: These are constructed of reinforced concrete walls and steel-frame roofs. The Administration Building is partly two and partly three stories in height; the other two are of one-story height.

Four production units and two storage buildings, all of one-story height, are of steel frame construction with specially insulated walls and roofs. These are Assembly Buildings 1 and 2, each 300 x 900 ft; Buildings 3 and 4 (fabrication structures), each 300 x 650 ft; Building 6 (factory and storage), 300 x 480 ft; and a warehouse (5), also 300 x 480 ft.

The roof trusses of the assembly and fabrication buildings have a clear span of from 70 to 150 ft, providing for vast unbroken working areas. One-inch Thermax slabs are applied to the underside of the tongue-grooved roof decks. Fireproofing of the walls is achieved with sidewall construction of Robertson

THIS PROJECT

Supervising Architects and Engineers—Edward Cray Taylor and Ellis Wing Taylor, Los Angeles

Consulting Engineer, Heating and Air Conditioning—O.W.Ott, Los Angeles.

Contractors, Heating and Air Conditioning—W. S. Kilpatrick & Co., Western Air & Refrigeration, Inc., and Howe Bros., Los Angeles.

Sixty-two of the 68 air conditioning systems are mounted on platforms built in the roof trusses. This view shows one of these platforms which contains a complete air conditioning system including refrigerating unit, coil, filters, and instrument panel.

(Left) Close-up of filter bank in platform air conditioning unit. Forty-two American Filter pads are used in each bank. Staynew filters are used in the office and cafeteria assemblies. (Below) Exterior view of the plant taken in August showing finishing touches being applied to the plant. Note wide spacing between buildings to minimize effect of bombs (dull exterior makes them less visible from the sky at night) and their windowless design to assure complete blackout in emergency.

asbestos-protected corrugated steel siding installed over one-inch Thermax slabs. These insulating slabs are made of shredded wood fibers mixed with cement binder in an open weave and serve the dual purpose of providing thermal insulation and sound absorption. The non-shattering quality of these slabs, which upon breaking will not divide into large pieces, is a safeguard against injury.

The heating system for nine of the buildings is a low-pressure 15-lb steam system, using Kewanee gas-burning boilers. Two other buildings are served by a low-pressure system operated at five pounds pressure, and also using a Kewanee boiler. Twenty-three boilers with a total rating of 254,540 sq ft E.D.R., installed in as many boiler rooms, constitute the decentralized system. The various boiler rooms are located so as to save as much piping as possible, thereby eliminating large steam and return lines and reducing heat loss from the radiation of the pipes. Six boilers with a total of 30,700 sq ft E.D.R. serve the office and cafeteria buildings, while 17 boilers in 17 boiler rooms, with total rating of 223,840 sq ft E.D.R., supply heat to four factories, a receiving-storage building, a warehouse, paint storage building, and the garage.

The plant has 68 direct expansion air conditioning units, 62 of which serve the manufacturing areas and the factory auxiliary buildings. Each unit serves its own zone and is entirely independent of the others. The units average 60 tons, for a total of more than 4,000 tons of refrigeration. Thirty-three of the units were furnished by York and 35 by Westinghouse.

Noteworthy is the overhead installation of the air conditioning and heat diffusion equipment in the factory buildings. Platforms, 20 x 25 ft in area, built into the roof trusses, support the air conditioning machinery, fans and heat coils, leaving the floor area free for manufacturing purposes. On each platform are located the evaporative compressor, condenser, cooling coils, supply fan and filter banks. There is also installed a heating coil in front of the air intake and a booster coil in the supply duct to the outside zone for each platform. This arrangement pertains to each of the 62 platforms.

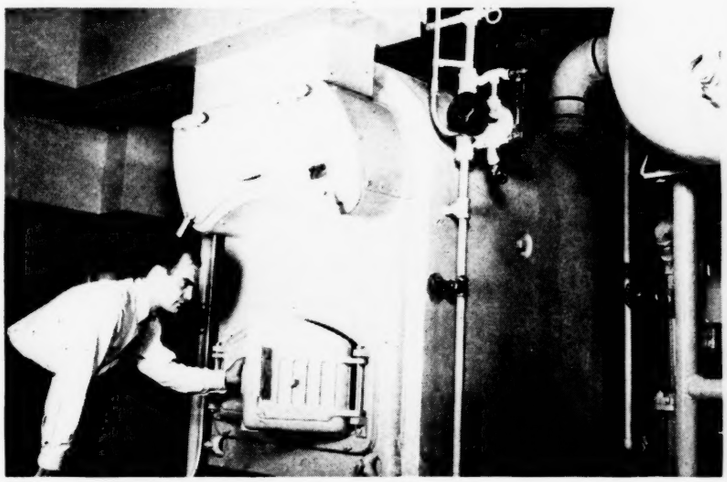
In the factory buildings, double adjustable direc-

TABLE 1.—DISTRIBUTION OF HEATING EQUIPMENT

Building	No. of Boilers	Boiler Rating
1—Factory	3	2 of 12,150 E.D.R.; 1 of 18,220
2—Factory	3	2 of 12,150 E.D.R.; 1 of 18,220
3—Factory	3	3 of 10,330 E.D.R. each
4—Factory	3	3 of 10,330 E.D.R. each
5—Warehouse	2	2 of 12,150 E.D.R. each
6—Raw Stock	2	2 of 12,150 E.D.R. each
7—Administration	3	3 of 4,250 E.D.R. each
8—Personnel	1	1 of 10,330 E.D.R.
9—Cafeteria	2	1 of 12,150 E.D.R.; 1 of 5,470
10—Paint Storage*	0	—
11—Garage	1	1 of 18,220 E.D.R.
	23	Total Rating, 254,540 E.D.R.

(*Paint Storage Building served by boiler in Garage Building).

(Below) Complete decentralization of the heating system is accomplished by using 23 gas-burning boilers in 23 separate boiler rooms. (Right) The air conditioning units in the Administration Building, Personnel Building, and Cafeteria are mounted above the ceiling. Air is expelled through Venturi-Flow ceiling outlets of the type illustrated here.



tional-flow grilles, mounted in the ducts, blow directly down from the platforms. The grilles are installed at the level of the bottom truss chord at heights above floor level ranging from 30 to 35 ft in the different factories.

The units in the Administration-Office Building, Welfare-Personnel Building and the Cafeteria Building are strategically located in upper-floor mountings and the unitory idea is again carried out, with air distributed through Barber-Colman Venturi-Flo ceiling outlets.

A single boiler room supplies heat for Building 10 (Paint Storage) and Building 11 (Garage). A Kewanee gas-burning boiler of 18,220 sq ft E.D.R. rating is installed in a boiler room in the Garage Building, from which heat pipes are carried through a tunnel to the Paint Storage Building. Unit heaters of the ceiling projection type heat these two buildings. Building 10 has four Trane Toreador model units mounted in the roof trusses, with duct nozzles for directing heated air in all directions. Building 11 is equipped with 15 Buffalo Forge unit heaters with direction louvers, also mounted in the trusses.

Ten buildings have from one to three boiler plants and eight buildings have from 2 to 15 fan stations and 2 to 15 refrigeration units. Distribution of heating and air conditioning equipment in the various buildings is as shown in Tables 1 and 2.

One of the problems which arose in designing the system was that of servicing the units in the roof trusses. This was taken care of by installing an elaborate system of inter-connecting catwalks which enable the service men to move from one platform to another without descending to the floor level. The catwalks are 3 ft wide and are protected by substantial railings. They are used also for servicing lights, cranes and other overhead equipment. Switches for controlling the mercury-vapor lamps are attached to the catwalk railings. The air conditioning platforms are also accessible through hatches in the roofs of the buildings.

TABLE 2.—DISTRIBUTION OF AIR CONDITIONING AND FAN EQUIPMENT

Building	Size of Bldg., Ft.	Height Under Truss, Ft.	Sq. Ft. Floor Area	Fan Stations No.	Fan Stations C.F.M.	Number of Refrig. Units	Total Refrig. Tonnage
1—Factory	300 x 900	35	270,000	15	35,000	15	860
2—Factory	300 x 900	35	270,000	15	35,000	15	850
3—Factory	300 x 650	22	195,000	12	35,000	12	717
4—Factory	300 x 650	22	195,000	12	35,000	12	704
5—Warehouse	300 x 480	30	144,000	8	35,000	*	000
6—Raw Stock	300 x 480	30	144,000	8	35,000	8	440
7—Administration	75 x 500	13	80,600	3	35,000	3	227
8—Personnel	75 x 300	13	22,500	1	24,000	1	144
				1	18,000		
9—Cafeteria	75 x 150	14	11,250	1	24,000	2	84
				1	2,500		
			1,332,350	77		68	4,026

*No cooling is provided for the Warehouse Building or the Garage and Paint Storage Buildings, at present equipped only with ventilating and heating systems. Platforms and other hook-ups, however, are in place, ready for installing refrigeration equipment at any time.

The ducts served by each fan are installed above the bottom chord of the roof truss which supports the platform. Consequently, the supply ducts in the factories are overhead. Return ducts drop to within 7 ft of the floor to provide adequate circulation of heated air in the working level.

All air is filtered with American or Staynew filters, one filter bank of 42 pads for each of the 68 conditioning units and eight ventilating units. American filters are used in the factory buildings, and Staynews in the Administration, Personnel and Cafeteria Buildings. Each unit has its own air intake. All buildings are zoned to take care of various exposures and to assure even temperatures regardless of the time of day.

The system is designed to cool the buildings to 80F dry bulb and 48% relative humidity in the factories, and 78F dry bulb and 50% relative humidity in the office and cafeteria buildings.

The decentralization of the refrigeration machinery also may be of value in years to come if the plant is split up for other uses. A zoned system, such as has been installed in this aircraft factory, is regarded as more practical than other types in that it can be operated more economically by simply shutting down whichever units are not needed.

Because of the windowless nature of the buildings, selection of proper lighting equipment was a point of major importance. Lighting is accomplished by 10,000 400-watt mercury-vapor lamps in the factories, and 15,000 fluorescent units in the offices, drafting rooms and cafeteria. In the factory areas, mercury-vapor lamps are mounted in low- and high-bay industrial reflectors at heights ranging from 22 to 35 ft above the working level. Office and cafeteria illumination is supplied by two- and four-lamp fluorescent lamp fixtures. The total lighting load for the plant for both types of lamps is 5000 kw.

Construction was started in December, 1940, by the Walker Construction Company of Los Angeles and called for completion within approximately six months. The pressure of national defense effort called for high speed construction.

How closely the six-months schedule was adhered to is evidenced by the fact that production of parts and sub-assemblies began in June. Douglas personnel moved in before the buildings were completed, some departments operating in temporary quarters. With the finishing phases of construction and installation still going on, more than 2500 Douglas employees were at work near the end of June. Building construction and installation of machinery in connection with the 11 buildings was 90% complete on August 15, when 4500 were at work. The original estimate called for 15,000 skilled workers, but present indications are that when the plant is in full operation the personnel total will approximate 18,000 to 20,000 in the construction of four-engine bombers of the Flying Fortress type, as well as Douglas military transports and attack bombers for the United States and Great Britain.

Since speed was so essential in erecting the plant, and to forestall bottlenecks and facilitate installation, the refrigeration equipment was handled by two manufacturers—York Ice Machinery Corp., and Westinghouse Electric & Manufacturing Co.

York 60 hp V/W compressors, stagger-tube, direct expansion Freon-12 coils, and York economizers supply 2032 tons of refrigeration for 33 individually mounted units in five buildings. These are Factory Buildings 1 and 3, Administration Building, Personnel Building and Cafeteria Building. Engineers of York's Los Angeles branch handled the installation of units in the Personnel and the Cafeteria Buildings. W. S. Kilpatrick Co., Los Angeles, installed York equipment in Buildings No. 1, 3 and 7 and the ventilating system in the Warehouse Building.

Westinghouse refrigerating units, averaging 50 to 70 hp, are in Factory Buildings No. 2, 4 and 6. The Westinghouse equipment—installed by Western Air & Refrigeration, Inc., of Los Angeles—consists of 18 type CLS 2550 Freon-12 compressors, and 17 type 1980 compressors, and evaporative condensers. There are a total of 105 direct expansion evaporator coils in the Westinghouse equipped buildings.

The main supply fans are the product of Buffalo Forge Co. Toilet exhaust fans and boiler ventilator fans are Sturtevants, and miscellaneous fans in the Administration Building ventilating system are by American Blower.

Venetian Blind Laundry Conditioned

A Venetian blind laundry—the first of its kind ever established—has been made possible through air conditioning. A 150,000 Btu Carrier unit heater maintains temperature at 120F inside the drying compartment at the unique laundry.

One of the principal drawbacks to the more widespread use of Venetian blinds had been the fact that there was no adequate method of cleaning them. No machine had been devised to wash them.

The laundering machine, 12 ft high, 15 ft wide and 25 ft long, accomplishes the laundering process by slowly moving the blinds, one at a time, through a washing compartment. The entire length of the blind is first evenly sprayed with a cleaning solution through a series of specially designed pipe slots.

The moving blinds then pass between two adjustable columns of four-inch long split Chinese pig bristle brushes, operating vertically, and adjusted for whatever scrubbing pressure against the blind may be needed.

Then the blinds are passed through another section of spray pipes which rinse off the cleaning solution.

From the washing chamber, the blinds are moved on an overhead track to the drying compartment, where warm air from the unit heater system is blown through the chamber by a twin-squirrel cage-unit fan. Temperature is maintained at 120F in the drying compartment and saturated air is not recirculated but discharged outside the building. The entire washing and drying require only 30 minutes.

CUMMINS ENGINE COMPANY

Indiana diesel manufacturer, builds new Research Laboratory with –25F refrigerated room for cold start tests; oil fired boiler with unit heaters, mechanical ventilation provided.

INCREASE in demand for diesel engines resulting from industrial expansion and the national defense program finds the Cummins Engine Company occupying new research and development headquarters at Columbus, Indiana, intended to provide the finest testing and experimental facilities in the diesel industry.

The compact research building, designed and built by The Austin Company, consists mainly of three portions—one occupied by a large experimental machine shop; the second, occupying one entire side of the building, devoted to engine testing facilities; finally, there are complete chemical and metallurgical laboratories.

For engine testing, six test rooms, 10 x 21 ft, have been provided, and each is equipped with a monorail and chain hoist of two or five ton capacity to facilitate the mounting of engines and their removal from test blocks. Individual Sturtevant ventilating fans, engine exhaust vents and fluorescent tubes mounted directly above the test blocks in each room provide ideal conditions for accurate testing and observation. The ventilation provides four air changes per minute.

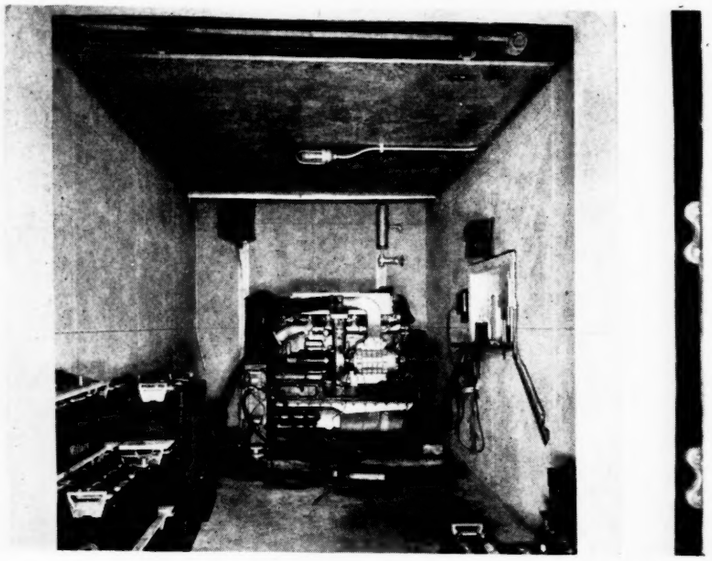
Cold starting tests are accommodated in a thoroughly insulated cold room which has refrigerating coils across the entire ceiling area and a heavy refrigerator door, and which can be cooled to —25F. While an observation window has been installed, a telephone is also provided so that observers inside the cold room can report their findings to the recorder outside. Tests are made at —10F to insure positive starting at zero in actual service.

The walls of this low temperature room are of 8 in.

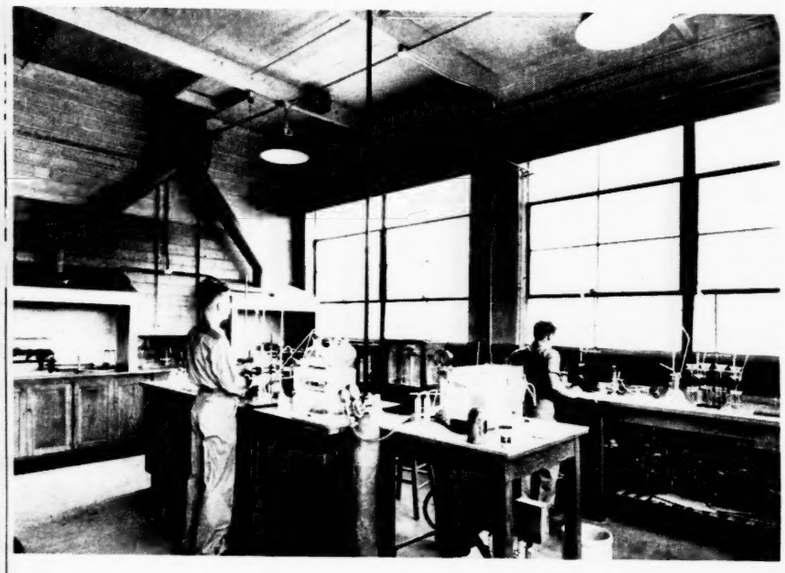
Project Described
Designed by
THE AUSTIN CO.

In this dignified and compact structure, the Cummins Engine Company is carrying on exhaustive tests of diesel engine performance in research quarters said to be the finest anywhere for exclusive work on diesels. Six test rooms, located along the side of the structure on the left, are served by special exhaust stacks.

(Above) The experimental machine shop with thermostatically-controlled unit heaters. (Below) This cork insulated "cold room" can be brought down to temperatures as low as —25F. The refrigerating coils can be seen here above the plywood ceiling. Test observers report by telephone to the outside.



(Below) One corner of the chemical laboratory. Note the arrangement of burners and their relation to exhaust stacks.



tile, plastered on the inside with Portland cement plaster, then painted with asphalt paint, to which was applied two layers of 4 in. cork with hot asphalt; finally, the cork was covered with two coats of Portland cement plaster. The 5 in. reinforced concrete subfloor was covered with two layers of 4 in. cork set in and mopped over with hot asphalt. Over the cork a 5 in. reinforced concrete finished floor was constructed. The ceiling is a 5-in. reinforced concrete slab and insulated in the same manner as the walls, but in place of a plaster finish this cork was covered with an asphalt emulsion trowelled on in two coats.

An observation window 20 x 30 in. was provided in one wall and it is constructed with five layers of glass.

The refrigerating unit, which is mounted on the roof of the room, is a York 4 x 4 in. double self-contained unit. The evaporator surface consists of ¾ in. galvanized trombone coils with welded headers and of flooded type design. The coils are located overhead in the room in such a manner as to be enclosed in a plenum through which the room air is forced by fans, thus realizing the highest efficiency of the evaporator surface. A drip pan with drain is suspended under the coils for defrosting.

The room temperature is controlled by a room type extended bulb thermostat which automatically starts or stops the compressor motor according to the adjustable range temperature setting.

The telephone system that is used for communication between the men in the room and the men on the outside who record the results of tests is equipped with operator's transmitter and receiver and is the shortest line in the Bell Telephone System, the distance between phones being only 16 in.

The building is heated by a steam heating system, with a Pacific low water line oil fired boiler, with a Ray oil burner and Minneapolis-Honeywell controls, supplying 4250 sq ft of equivalent radiator surface. A Nash condensate pump is used. The heat is distributed by Sturtevant propeller fan type unit heaters under Minneapolis-Honeywell thermostat control.

Ventilation is provided by an H. H. Robertson 36 in., 8650 cfm ventilator, and 13 Sturtevant Axiflo fans as follows: one 27 in., 8000 cfm; three 21 in., 5500 cfm; two 21 in., 3500 cfm; three 24 in., 9100 cfm; and two 30 in., 11,350 cfm. There is also a Sturtevant Silentvane fan and a 285 cfm Multivane fan.

Some of these fans were used for special ventilating problems, but most of them were used for general ventilation. For the machine shop areas an eight-minute air change was provided; for the metallurgical laboratory, a three-minute air change.

The chemical and metallurgical laboratories are completely equipped with modern testing equipment for close and continuous control over all of the materials used in engine production and to check experimental work.

Offices have been provided for the engineering staff and Don J. Cummins, who supervises the research and development work. Details of the entire structure were worked out by Austin engineers in close collaboration with the Cumminses and A. F. Loertz, plant engineer.

PROFITS IN AIR

DIXIE MERCERIZING COMPANY

installed electrostatic air cleaners to eliminate dirt and smoke which formerly ruined 10 to 15% of the yarn. These air cleaners have paid for themselves out of savings made over a period of two years.

THE Dixie Mercerizing Company in Chattanooga, Tenn., is located in a community where there are over 400 industrial establishments, the majority of which burn soft coal as fuel. The problem of smoke, dust, and gases in the air is, consequently, a problem with this company.

The yarn is received in skeins in its natural yellow-white color. Going through one of a number of typical procedures, the skeins are unwound, passed through a mercerizing process and then dried. The yarn is dried by loosely laying it on a wire screen conveyor which moves slowly back and forth at different levels through the oven. Heated air blown onto the yarn speeds the drying process.

As the color of the yarn after mercerizing is a silky white, any dirt entering the oven will stick to the moist yarn causing streaks which washing and even bleaching cannot remove.

After dyeing, the packages of yarn, still moist, are placed on drying tables where heated air is forced through the package, from the inside out. Acting like a filter, the yarn collected all the dirt and smoke particles in the air, blackening as much as 1/2 to 5/8 of an inch thickness of the yarn. This represents about 10 or 15% of the yarn in the package. The remainder was almost always of questionable quality.

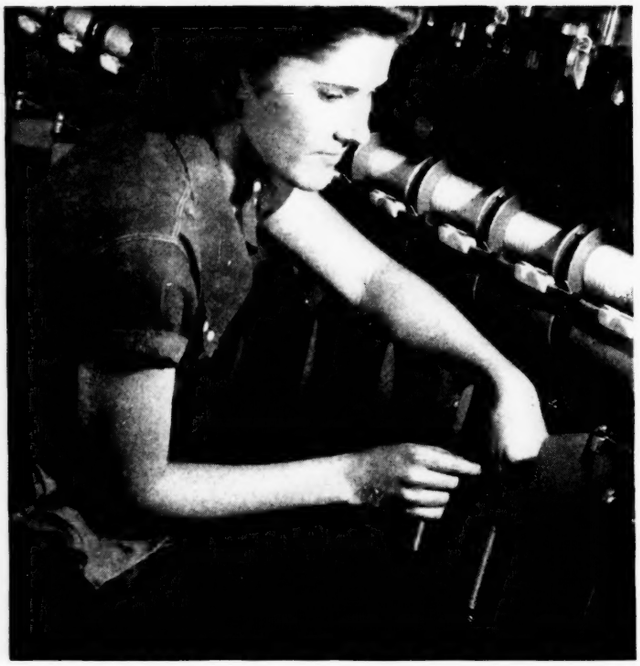
In the winding operation, the bleached or dyed yarn is wound on cones in preparation for shipment. Because of the high speed of rotation of the cones (5000 rpm) dirt in the room air was kept in suspension, and constantly in evidence around the spinning cones. The result was that the bottoms and tops of the revolving cones of yarn collected a high percentage of the dirt and smoke particles surrounding them. As the dirt and smoke problem became more acute mechanical filters were put in the air systems. The larger dirt particles were eliminated but the yarn still got dirty on smoky days.

An installation of electrostatic air cleaning units followed. They were placed in the forced air systems feeding the mercerizing dryer and the package dryers. Now on the mercerizing drying operation clean yarn is realized even on the smokiest days. In the package drying operation the number of contaminated packages has been reduced almost to zero.

In addition, the cleaners have resulted in a sharp reduction in the number of seconds, or lower grade yarns, and have cut down most of the reprocessing that was essential before, even to the production of these second grade yarns. No concrete record has been kept of the actual money saved by the cleaners since their installation in 1939 but, from the information available it seems reasonable to believe that they have just about paid for themselves after two years of operation.

At the Dixie Mercerizing plant the yarn, after drying, is dried from the inside out by forcing heated air around the packages. The canvas cover retards the escape of the heated air as shown here.

Precipitrons clean the heated air used in the mercerizing dryer in the Dixie plant. This view shows the yarn coming from the dryer after 90% of the smoke particles had been removed from the drying air.



An operator in the Judson Mills is about to join the two broken ends of rayon thread. Such breaks, which result from dirt collecting on the guide bars and frame wires, thus increasing friction, have now been practically eliminated by the use of air cleaners.

In another rayon and cotton cloth weaving mill, greasy soot particles collected on the flyer wires during winding, increasing friction so much that the thread would break. After the installation of electrostatic air cleaners production was increased by reducing the number of rejects and returns because of filling flasks. The yarn was cleaner and maintenance and cleaning costs were reduced one third.

Locating Units

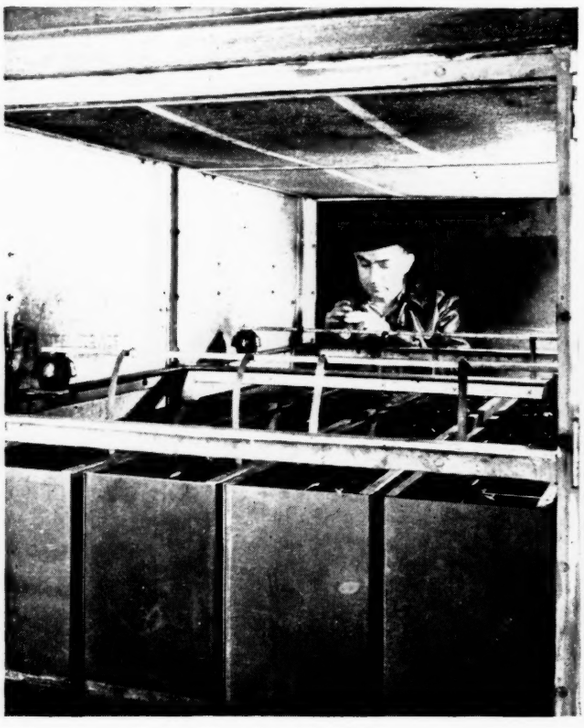
The location of the electrostatic air cleaners in relation to other equipment in an air conditioning system is governed by several factors. It should be so located that it will clean both the recirculated and the fresh air. It should be on the upstream side of the humidifier, although it may be placed on the downstream side if provision is made to prevent spray from being carried into the cleaner.

In any installation, regardless of the number of cells employed, it is important that the incoming air be most efficiently distributed over the entire surface of the cleaning unit.

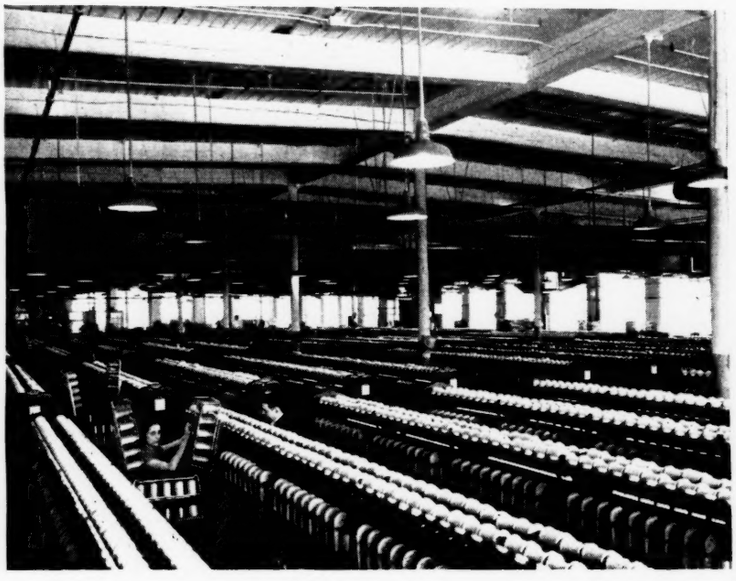
In relation to heating and cooling coils, the cleaner may be located on either the upstream or downstream side. It is usually located ahead of the coils in the air stream to remove the dust before touching the coils.

Precipitrons consist of two major parts, the cell and the power pack. The cell is composed of two sections, an ionizer and a collector. The ionizing section, located on the leading edge of the cell, is composed of fine tungsten wires and grounded metal rods. A direct voltage of 13,000 is applied between the alternately spaced wire and rod, creating a strong electrostatic field between them. As the air to be cleaned passes between the wires and the grounded rod the particles of foreign matter, regardless of shape or size, receive an electrostatic charge. The air, after having its particles charged, passes into the collecting section. Here the parallel collector plates, charged with 6000 volts and spaced 5/16 inch apart, are located. Since unlike charges attract, these charged particles are attracted to the plates and grounded. A light oil film on the collector plates holds the particles once they are collected and this material may merely be washed down with water.

Included in the power pack apparatus are: a high voltage transformer to *step up* the standard a-c supply, high vacuum rectifier tubes to change this voltage from a-c to d-c and capacitors to smooth out this pulsating d-c voltage.



(Left) The operator is oiling the collector plates of the Precipitron unit which is cleaning air for the package process in the Dixie Mill. (Below) General view of the rayon spinning room at the Judson Mills showing the Bahnson Humiducts suspended from the ceiling. Of the 16 ducts, eight are equipped with Precipitron units while the other eight are used only for recirculating inside air.



GENERAL ELECTRIC COMPANY

builds air conditioned blackout factory for manufacturing aircraft engine superchargers. Air conditioning and heating system divided into six zones; ventilation provided for sand blasts, electric air cleaners for welding booths.

PROFITS IN AIR

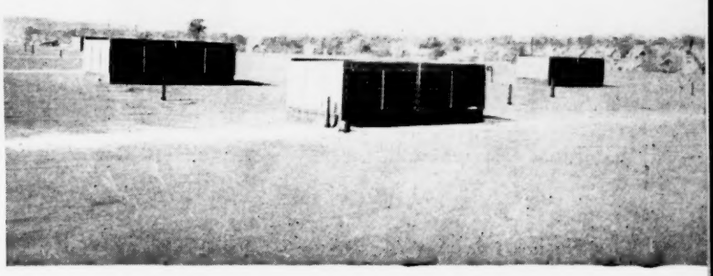
No. 61 OF A SERIES DEALING WITH ATMOSPHERIC CONDITIONS IN INDUSTRIAL PLANTS

NEW England's second large windowless factory and its first blackout plant has been erected by the General Electric Company on a 47-acre plot of salt marshland in Everett, Mass. Costing $1,500,000 and built with government funds from the Defense Plant Corporation, it is one of seven or eight windowless plants built or being built in different parts of the country for various types of national defense work.

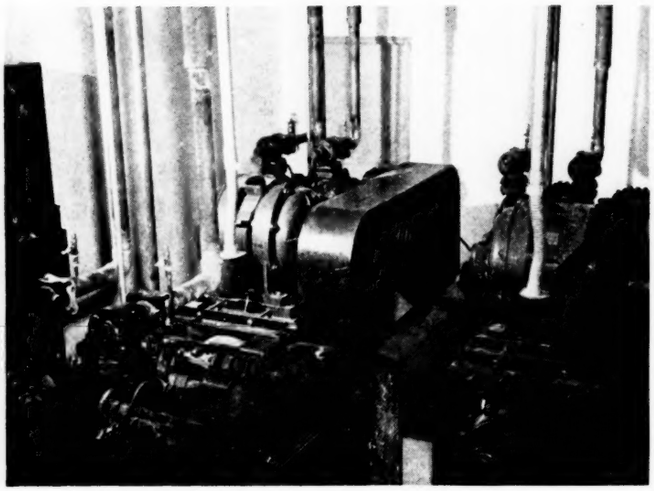
The plant was designed by J. C. Trudinger, plant engineer at the River Works of General Electric Co. at Lynn, Mass. General Electric engineered the air conditioning, which was installed by Cox Engineering Company.

A huge, one-story brick structure, this plant provides more than five acres of production space under one roof for the manufacture of superchargers for United States Army and Navy planes—devices which permit the planes to fly at altitudes up to 40,000 ft or more, or at greater heights than any bombing and fighting planes could attain without them.

The plant consists of a main manufacturing section, 400 x 500 ft, planned for straight-line production, with raw materials entering at one end and the finished



(Left) The General Electric Company's new windowless supercharger plant at Everett, Mass. (Right) Air intakes on the roof.



Typical compressor room in the mezzanine.

product leaving at the other, and an auxiliary attached building, which combines a boiler house, test, and forge shop, 80 x 100 ft.

In the construction work, little more than three weeks elapsed from the time the Bethlehem Steel Company delivered the first sixteen carloads of pre-fabricated steel until the 1600 tons total required for the entire framework has been erected by the Turner Construction Company, general contractors. Maximum speed was also recorded in the prior placement of footings by the Raymond Concrete Pile Company, which sunk a total of 770 caissons at the average rate of about 25 a day. Equal speed was shown by the Turner Company in walling up the structure, placing the roof, and interior finishing.

Exterior walls are of brick, with a steel truss roof and a steel framework. Over this framework is laid a steel deck that also serves as an acoustical ceiling and dampener of noise. Engineers say that noise created at one end of the building can not be heard at the opposite end. The roof is so constructed and camouflaged that it is entirely blacked out at night and will be practically invisible from above in daytime. Interior walls are faced with buff colored ceramic tile, and therefore easy to keep clean. Roof insulation above the steel deck is 2 in. thick and below this a 1¼-in. acoustic rock cork ceiling. Air conditioning ducts are not insulated; they are located in the truss space, threaded through the trusses.

The entire manufacturing space is uniformly lighted by the newest type of fluorescent lamps, giving 50 foot candles at working level, the units consisting of two 100-watt, 60-in. tubes, mounted in continuous reflectors, extending at frequent intervals the entire length of the building. Certain areas have additional fluorescent lighting to increase the foot candle intensity to the extent required by the work in progress. Total lighting load is 600 kw.

Load

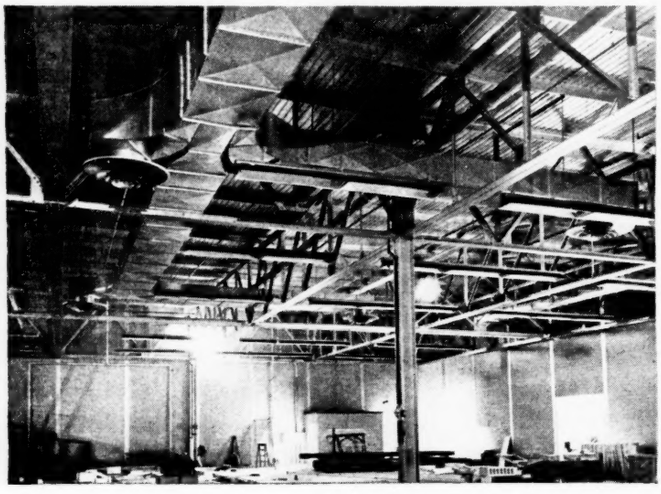
The building has a total cubic content of 5,200,000 cu ft. An interesting feature is that 60% of the heat gain is internal. In the winter time there is enough internal heat from the electric furnaces, other machinery, and from the 1200 employees on the day shift, 800 on the second and 600 on the third, to care for the winter heating requirements for the building when it is 15F outside so that heating will only be necessary below this temperature. Heat loss with the building occupied is 4,000,000 Btu per hour.

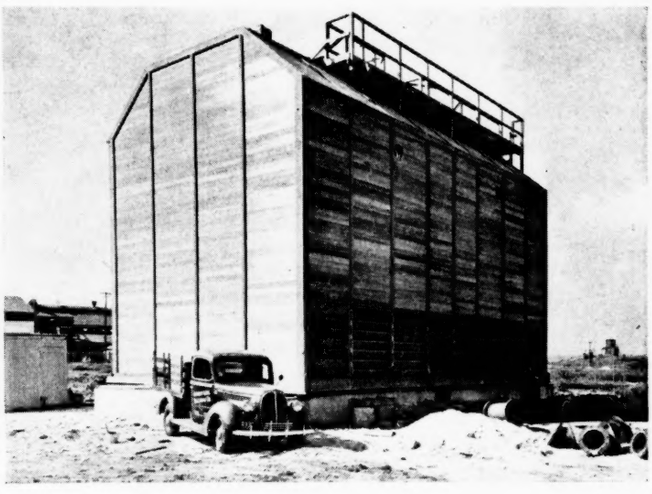
The air conditioning system is designed to maintain 80F when it is 91F outside with no attempt to control the humidity.

When the outside temperature is lower than that inside, air is rejected to the outside by 18 Buffalo Forge exhaust fans, each of 13,500 cfm capacity, three for each zone.

Heating and Cooling

The air for heating and cooling is handled in six individually controlled zones each caring for approximately one-sixth of the area or about 40,000 sq ft. Total air volume of the system handled by 100,000





(Left) One of the mezzanines for air conditioning equipment. In this picture is shown the ceiling discharge outlets and metal ducts. Outlets in the office and cafeteria are Anemostats, with Uniflo grilles in the laboratory and Venturi-Flo outlets in all the remaining positions. (Right) View of the cooling tower taken while tower was under construction several months ago.

cfm capacity American Blower fans is about 600,000 cfm of which 100,000 cfm is fresh air and the balance is recirculated. Equipment for each of the zones is on centrally located mezzanines from which air is distributed by standard ductwork.

Fresh air is brought in through hooded louvered intakes on the roof, passed through automatic type American air filters, then discharged through 116 diffusers located about 18ft above the floor. The diffusers are located in the center of a 40-ft bay with downward angle discharge at a velocity sufficient to provide thorough mixing of the discharge air at the floor level. The discharge temperature is 20F below room temperature under cooling conditioning and 20F above room conditions for heating. Fresh air introduced into the system at the rate of 100,000 cfm is enough for four air changes per hour but this is reduced, at the heating and cooling peak loads, to one air change per hour.

Cooling

Cooling is provided by six direct expansion systems with a total capacity of 1140 tons of refrigeration. The equipment consists of 18 General Electric 60-hp 8-cylinder reciprocating condensing units.

Condensing water is cooled by a Foster Wheeler cooling tower located outside of and adjacent to the building with underground piping covering a 90-ft distance between the tower and the building. The tower is 24 x 45 ft in area, 29 ft high and has a capacity of 3000 gpm when the cooling system is working at design capacity. The tower stands on concrete ribs placed on top of a fuel oil tank of reinforced concrete buried in the ground.

Cooling water is circulated by an Ingersoll-Rand pump driven by a 75-hp General Electric turbine. Steam for the turbine is exhaust steam from manufacturing processes.

Heating

Heat is by means of steam coils modulated in six stages for each zone and designed to deliver air at a maximum outlet temperature of 25F above room temperature under design conditions. The plant has three Babcock & Wilcox boilers each with a rating of 60,000 lb of steam per hour and one of these is reserved for steam when necessary. The other two are provided for steam testing of the superchargers.

Ventilation

Sand blasts are all grouped in one room so as to keep the rest of the plant free from dust. There are six banks of these blasters, all dust from which is exhausted through roof vents.

Dust control hoods are provided for ventilation of machines that create dust. Electric precipitators are provided for the welding booths so that the air can be cleaned, then recirculated. The cafeteria and infirmary are tied in to the main air conditioning system, with exhaust through and from the kitchen. Toilet spaces have separate ventilation and exhausts.

The gas testing room, where superchargers are tested by means of hot exhaust gas for altitude performance, and the steam supercharger testing room have a separate air conditioning system, with air ejectors for the gas testing room. Canopies and vestibule entryways serve as light traps so that no light escapes outside to be seen by raiding airplanes.

View of Mezzanine room. On left, automatic oil filters for taking in air from outside (louvers in ceiling) as well as return air from plant (louvers at right).

Controls

Since rapid changes of indoor temperature are possible with fluctuations in operation of the machines, sensitive Johnson Service controls were used. These fluctuations occur at mealtimes, shift changes or intervals when a considerable part of the machinery is shut down.

The plant was designed to build superchargers for high-flying bombers and fighters. The supercharger, itself, is the result of development work dating back to the first World War by Dr. Sanford A. Moss. The supercharger is a miniature turbine driven by the exhaust gas from the airplane engine. It is only 18 in. overall and weighs but a few pounds. It is said to be one reason for the superiority of American planes.

Blowers for Airplane Engine Tests

Two large blowers, each powered by a G E. 2000-hp motor, will deliver sufficient cooling air to airplane-engine test stands at Wright Field, Dayton, to absorb 20,000,000 Btu per hour.

When set up for testing, the airplane engines will be fastened to torque stands, and test propellers attached to furnish load. With this method of testing, all the output of the engines is released into the air in the form of heat. To cool the engines and to get rid of this heat, blowers, installed below the engines, will pull air from outside over the test stands and through a floor opening, and then discharge it outdoors.

How the Defense Program is Affecting Buying and Selling Contracts

By CHARLES R. ROSENBERG, JR.†

BUYING and selling practices that the heating and ventilating contractor has always found to be safe and sound are just as reliable as they always were; but to-day they will not necessarily see him safely through the deep waters of the national defense program. New and unfamiliar legal viewpoints are appearing on the business scene. "Protective" clauses are finding their way into contracts. There's an almost complete lack of trustworthy guideposts to sound buying and selling policy and practice. Moreover, the indefiniteness of the whole situation hits the heating and ventilating contractor both as buyer and seller.

Manufacturers of equipment, for example, are increasingly hesitant about committing themselves on price and delivery. If they seem to be hedging on the contractor's orders, it's because they have no way of forecasting the trend of priorities, price control, and production changes imposed by the national defense program. The overshadowing question that confronts them is how much of their civilian production will have to be dropped in favor of defense work; and to that an individual answer will probably have to be worked out for each producer according to his conditions.

Because the operations of the contractor are of course essential to the civilian economy of the country, a workable schedule of allotments of material and production will no doubt be worked out in due time for heating and ventilating installations for civilian use. Meanwhile, suppliers of equipment and material are of necessity wrapping themselves in protective devices; some contractors call them legal tricks, but this is a little unfair. Tricks or no tricks, heating and ventilating contractors may find themselves forced by conditions to adopt them in their dealings with their own customers.

It's no longer safe, for example, for a contractor to take a manufacturer's or supplier's quotation on equipment or material at face value. A contractor cannot safely assume that an order forwarded by him in response to a quotation on equipment or material creates a contract insuring delivery of the items ordered at the prices quoted. It's elementary law that when an offer is accepted, there's a contract binding on both sides. But a quotation or what seems like an offer of named goods at a specified price may not be an offer at all!

In one typical case a man was asked to state his lowest price for certain items. He named his price in a telegram, and a telegram agreeing to buy the goods at his price was immediately sent in reply. In subsequent legal proceedings the court decided that the reply telegram was not an acceptance of an offer but was itself an offer which would not mature into a binding contract unless and until accepted by the prospective seller.

The courts say that a price quotation may be nothing more than "an invitation to deal," that the would-be seller is simply announcing that he will *entertain offers* for the goods at the prices set forth. He isn't bound to sell or deliver until he in turn accepts the offer—the contractor's order, for example.

If the supplier seems to be crossing his fingers when he quotes prices, the contractor is himself in a similar situation when he submits an estimate to a customer or prospective customer. Nowadays, a contractor cannot risk being bound two or three weeks hence by an acceptance of an estimate he submits to-day. Not only may prices have increased, but some of the material figured on may not be available at all. Certainly, under to-day's conditions, it is not unreasonable for a contractor to take the position that his estimate on a job is simply an invitation to submit an offer which he shall be free to accept or reject, as he sees fit. Some contractors make this absolutely certain by including in all estimates some such saving clause as this: "This estimate is submitted on the understanding that any order based on it may be accepted or refused when received."

When the contractor is buying, he may of course receive from manufacturers and suppliers price quotations that are genuine offers which may be turned into binding contracts for the goods by his accepting order. The legal effect of such a price quotation offer may depend largely on the wording. One form of offer or quotation which can *practically never* be turned into a contract by the contractor's order, however, is that embodied in an advertisement, a circular or even a circular letter.

Thus, in one case, a supplier sent out a letter to the trade giving quotations on certain goods and specifying the manner of shipment. "Shall be pleased to receive your order," was the final sentence of the letter.

Was this an offer by which the writer of the letter intended to be legally bound upon its acceptance by one or more interested recipients? One prospect thought so and sent in his order. A lawsuit resulted when the order was not filled.

"The letter," said the court which decided the case, "is clearly in the nature of an advertisement, or business circular, to attract the attention of those inter-

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ested to the fact that good bargains in the goods could be had by applying to them, and *not as an offer* by which they are bound, if accepted, for any amount the person to whom it was addressed might see fit to order." (Moulton vs. Kershaw, 59 Wisconsin, 316.)

It's impracticable, of course, to put every letter or quotation through a legal x-ray to determine whether or not it embodies a bona fide offer; contractors who attempted it would soon find themselves mired in legal technicalities. They can easily and safely, however, follow this legal rule of thumb: don't count on having a valid contract for the goods ordered until a *formal acceptance of the order* has been received from the supplier!

Even where the supplier submits a bid or quotation by which he is unquestionably bound if accepted, the whole situation may be ruined by the wrong kind of acceptance, an acceptance that will give the offeror an easy out if he wants to take it. Thus an acceptance that varies the terms of the offer even slightly is no acceptance at all; it is, in law, a counter-offer which the original offeror may in turn accept or reject as he sees fit. For example, an offer of items on terms ten days net is not accepted by a purported acceptance specifying terms thirty days net. Even slighter variations than that may destroy the legal effect of the original offer and leave the buyer without an enforceable contract for the items he needs.

Time was—and not so very long ago—when a supplier did not care how a buyer's order reached him, so long as he got it. To-day, with every manufacturer in the country wondering how long and to what extent, if any, he'll be able to keep up production for civilian use, small details of this offer-and-acceptance business have become extremely important. They may mean the difference between a contractor's getting or not getting a legal grasp on his fair share of the items that the manufacturer is able to produce for civilian use.

For example, a bona fide offer of goods must be accepted within the time and in the manner specified in the offer itself. Thus an offer which calls for an acceptance by "telegraph within twenty-four hours" is *not* accepted by an air mail acceptance within twenty-four hours or a telegraphic acceptance after twenty-four hours.

Some manufacturers and suppliers ask the contractor to "forward your order or acceptance by mail" or, in some cases, "by return mail." Others call for the "receipt of your acceptance by us." There's a tremendous practical difference from the viewpoint of the contractor who is ordering the goods. A bona fide offer that asks for acceptance by mail or return mail matures into a binding contract the moment the acceptance is dropped into a post office or a government mail box. No subsequent withdrawal of the offer by the seller can undo the contract, even if the withdrawal be made before the seller actually receives the mailed acceptance.

But suppliers are protecting themselves from that possibility to-day by stipulating very clearly—where they are making a bona fide offer—that they are not bound until the acceptance or order has been "received and accepted" by them. Another reason for contractors to request formal acceptance or confirmation of their orders by suppliers!

The time element in the contractor's buying of equipment and material has assumed an importance to-day that it never had before. If a contractor has a bona fide quotation and wants the goods, he should accept without delay—before the opportunity is lost. An offer may be withdrawn at any time before it is accepted. This may be either by a direct and formal withdrawal or by information conveyed to the contractor by a reliable source that the offer has been withdrawn or that the goods offered have been sold to someone else. It's too late to accept then.

Legally and practically, a statement by the supplier that "We will hold this offer open for ten days" means nothing. He is under no legal obligation to wait that long for the contractor's decision; he may withdraw the ten days offer in one day if he sees fit. Such impromptu withdrawals of quotations before the stated time have been condemned by some contractors as sharp practice. Such criticism might be warranted under ordinary conditions, but the exigencies of to-day's national emergency are apt to sweep overboard, without warning, the usual business amenities.

An offer or quotation submitted without time limit needs no withdrawal to put it beyond reach of the contractor. That's true, too, of estimates submitted by the contractor to his prospective customers, without time limit. Such untimed offers or quotations are said to be good for "a reasonable time." They lapse if not accepted within that rather vague period. There is no fixed period for a "reasonable time"; it depends on the nature of the goods and the transaction, trade and industrial practices, and the surrounding circumstances. Under to-day's swift-moving developments in most industrial fields, a reasonable time for the acceptance of an offer or quotation on equipment or material is brief, to say the least.

Assume that a contractor has given his order and has received a formal acceptance from the supplier. May he then rest secure in the comfortable certainty that the goods will be delivered in due course? He may—*unless!*

Unless delivery becomes illegal, for instance. Suppose the government, under the necessities of the national defense program, orders the manufacturer or supplier to deliver his entire output to the government and to make no further deliveries to any private customer, except perhaps on priority jobs. Obviously, unless the items are for use on a priority job, performance of his contract with the contractor by the supplier is then impossible—and through no fault of the supplier. An order made with proper authority by a judge or an executive or administrative officer of the government forbidding the performance of his contract relieves the manufacturer or supplier of his legal obligations to the contractor whose order he accepted. Performance of the contract is excused because of legal impossibility.

But these situations, created by governmental requirements for national defense, may not be entirely hopeless from the viewpoint of the contractor who is waiting on equipment and supplies he has ordered. For example, there's the not unlikely case of a con-

tractor's order for items whose manufacture ordinarily requires the use of certain metals or other materials vital to the national defense. If the government should seize all that material or metal for defense purposes, and if the items could not be produced with any other material, performance of the contract by the manufacturer would of course have been made impossible, both physically and legally, by the government's action.

Yet, if in the particular case, the government had not absorbed the manufacturer's productive facilities and the items could be produced satisfactorily with other and readily obtainable material, the supplier would be legally obligated to go through with his contract for the items with the substitute material. In law, this is known as the principle of "unsubstantial variation." The performance of the contract by the manufacturer is not made legally impossible if he can go ahead with other material without any substantial variation in the finished items. The manufacturer's contractual obligation would be emphasized in such circumstances if the material to be substituted were no more expensive or more difficult to get than the material originally intended and if the substitution were approved by the ordering contractor.

Instead of leaving the outcome to the operation of law *after* the situation develops, contractors might do well to insert an appropriate provision for performance with "unsubstantial variation" in all orders and contracts for equipment and supplies where there is a possibility that such conditions might arise. Such a clause might extend to substitution of material or parts, modification of specifications and even change of design, within limits. It would not only operate to the advantage of the contractor in obtaining delivery, but would also enable the manufacturer to go ahead with assurance of definite leeway if he should find himself held up for materials. Certainly no reputable manufacturer or supplier in the industry would take unfair advantage of such a clause; for there will be other days, later on, as there have been in the past when a record of fair dealing with contractors will be a manufacturer's most valuable selling asset.

Partial diversion of a manufacturer's productive capacity to defense work may make it possible for the contractor to take advantage of the legal doctrine of "ratable apportionment." Suppose, for instance, that a manufacturer who has accepted a contractor's order for equipment is required by the government to devote sixty per cent of his capacity to defense production. Other things being equal, the government has made his performance on the contractor's order and other civilian contracts only sixty per cent impossible. Consequently, his civilian customers are entitled to their respective "ratable shares" of his civilian capacity. The contractor, therefore, could require performance and delivery of forty per cent of his order. The value to the contractor of such partial performance would of course depend on the nature of the goods and the job for which they were intended. Of course there are some jobs on which delivery of anything less than one hundred per cent of his equipment and material would be utterly useless to the contractor.

If priorities, defense production or other incidents of the developing defense program make it only temporarily impossible for a manufacturer to fill a contractor's accepted order, he may be required, legally, to produce and deliver the contractor's items after the temporary interruption has passed, provided performance at that time will not impose any greater hardship on him than performance at the time originally intended would have done. That's only reasonable, because meanwhile labor, material and other costs may have risen so that performance at the original contract price would be ruinous: the supplier cannot be compelled to perform later under those conditions.

Anticipating the possibility of later performance after an interval of "impossibility" due to defense production, the contractor should insert in his order or contract for equipment a provision to the effect that he shall have the option of requiring or waiving such postponed performance. It is quite possible, of course, that the contractor would no longer have use for the items after a considerable period of delay, and in that case he would not want to be forced to accept a deferred delivery. The job for which he intended the goods might have slipped out of his hands in the meanwhile.

One of the chief bugaboos of all suppliers just now is the type of contract requiring a schedule of deliveries over a considerable period in the future: for example, a contract for the delivery of 1000 items a month for ten successive months.

The catch in such a contract from the supplier's point of view is that it may be construed to be "non-severable," that is, a unit contract for 10,000 items instead of ten separate sales and deliveries of 1000 items each. Under the non-severable type of contract, a failure of one month's delivery might be construed as a breach of the contract as a whole, with the possibility of heavy losses and liabilities falling upon the luckless supplier. To meet this objection, contractors placing such orders for equipment and material might agree that failure of one month's delivery shall not be deemed a breach of the contract as a whole, or that the supplier might avoid liability for such failure by giving a specified advance notice of his inability to make a particular delivery.

Certainly manufacturers and suppliers do not want to disappoint contractors on performance and delivery; quite the contrary. By inserting protective conditions and clauses in their contracts and acceptances of orders, they are frankly warning contractors of what may happen under the development of the defense program. In substance, they are saying: "We hope and expect to fill your order, but if conditions incident to national defense make it impossible for us to do so, we do not want to be blamed for a failure that is not our fault."

Surely that's as fair and straightforward as contractors can ask for under present conditions. It is, in fact, the only safe policy for a contractor to follow in his dealings with his own customers. Patriotic support of the defense program implies uncomplaining acceptance of its economic effects by all.

DEGREE DAYS (65F BASE) FOR RECENT HEATING SEASONS

Degree day data by months for the heating seasons from 1927 to 1936 for a large number of cities appear in the Degree-Day Handbook. On this Reference Data sheet and on Reference Data sheet 209-210 are presented similar data for the same cities for the heating seasons since 1936.

Heating Season	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Total
MINNEAPOLIS, MINN.											
1936-37.....	92	579	1044	1316	1847	1445	1180	615	198	74	8390
1937-38.....	166	571	994	1460	1593	1208	834	577	297	29	7729
1938-39.....	119	323	1005	1384	1404	1563	1110	680	126	39	7753
1939-40.....	149	542	820	1154	1816	1326	1264	639	298	29	8037
1940-41.....	116	347	1115	1335	1478	1408	1145	378	132	65	7519
NASHVILLE, TENN.											
1936-37.....	1	166	582	658	555	696	597	217	59	—	3531
1937-38.....	34	260	564	794	807	433	267	159	35	—	3353
1938-39.....	24	107	457	727	635	582	377	260	56	—	3225
1939-40.....	7	139	537	661	1242	733	548	259	95	1	4222
1940-41.....	51	90	502	584	758	794	639	95	35	—	3548
NEW HAVEN, CONN.											
1936-37.....	79	343	731	897	847	881	946	531	142	8	5405
1937-38.....	127	396	626	991	1118	888	732	450	229	28	5585
1938-39.....	114	247	581	954	1117	868	898	575	213	19	5586
1939-40.....	76	354	728	952	1304	988	988	602	213	57	6262
1940-41.....	106	443	658	912	1184	985	956	355	166	45	5810
NEW ORLEANS, LA.											
1936-37.....	—	12	178	290	88	262	229	28	—	—	1087
1937-38.....	—	41	246	330	336	157	28	66	—	—	1204
1938-39.....	—	7	186	299	217	175	84	40	—	—	1008
1939-40.....	—	26	159	221	683	338	119	48	—	—	1594
1940-41.....	1	3	159	186	290	331	245	—	—	—	1215
NEW YORK, N. Y.											
1936-37.....	46	261	681	795	759	845	882	479	104	5	4857
1937-38.....	91	328	581	916	1022	822	645	372	178	21	4976
1938-39.....	53	218	525	863	1013	774	811	513	135	6	4911
1939-40.....	24	293	654	887	1239	930	933	571	179	31	5741
1940-41.....	64	371	602	810	1089	941	908	291	121	33	5230
NORFOLK, VA.											
1936-37.....	4	91	449	584	416	646	577	251	48	—	3066
1937-38.....	16	209	414	714	741	513	350	175	59	5	3196
1938-39.....	11	150	307	617	611	433	413	232	104	—	2878
1939-40.....	—	129	444	640	1054	657	561	301	66	—	3852
1940-41.....	26	182	368	521	760	753	648	203	46	4	3511
OKLAHOMA CITY, OKLA.											
1936-37.....	47	230	526	644	1071	685	577	192	18	—	3990
1937-38.....	14	172	581	848	745	547	260	233	47	—	3447
1938-39.....	9	78	508	710	623	774	338	208	23	—	3271
1939-40.....	12	89	463	578	1245	709	406	228	19	1	3750
1940-41.....	21	44	581	682	733	689	581	148	8	—	3487
OMAHA, NEB.											
1936-37.....	66	403	823	1099	1677	1197	919	458	103	27	6772
1937-38.....	69	389	868	1178	1255	1021	623	368	171	4	5946
1938-39.....	59	165	792	1063	993	1258	795	432	40	8	5605
1939-40.....	67	309	704	953	1761	1162	911	473	161	6	6507
1940-41.....	72	145	906	1068	1211	1085	865	303	60	27	5742
PEORIA, ILL.											
1936-37.....	58	350	816	967	1277	1040	892	465	137	23	6025
1937-38.....	115	427	852	1186	1205	807	544	377	161	7	5681
1938-39.....	81	206	665	1088	1019	1050	749	527	92	17	5494
1939-40.....	49	305	715	965	1602	1030	903	456	217	2	6244
1940-41.....	95	204	804	962	1136	1105	919	298	89	4	5616
PHILADELPHIA, PA.											
1936-37.....	37	221	646	788	731	814	818	411	73	2	4541
1937-38.....	75	317	562	902	974	770	597	318	141	12	4668
1938-39.....	44	193	498	851	946	719	724	446	107	3	4531
1939-40.....	16	264	601	836	1227	877	853	501	122	6	5303
1940-41.....	53	335	558	764	1030	929	856	236	79	21	4861
PITTSBURGH, PA.											
1936-37.....	48	293	738	815	769	890	879	455	131	1	5019
1937-38.....	119	425	689	1008	1013	751	558	358	156	6	5083
1938-39.....	66	269	576	916	911	798	719	486	122	3	4866
1939-40.....	30	297	671	864	1381	950	909	504	182	21	5809
1940-41.....	99	331	645	762	1045	1029	983	253	146	7	5300
PORTLAND, ME.											
1936-37.....	187	452	871	1061	1037	969	1043	650	292	78	6640
1937-38.....	180	481	737	1179	1282	1078	966	615	389	82	6989
1938-39.....	195	371	692	1057	1280	1125	1107	729	373	141	7070
1939-40.....	170	472	836	1116	1421	1101	1072	738	389	150	7465
1940-41.....	175	528	829	1263	1479	1138	1173	557	317	139	7598
PROVIDENCE, R. I.											
1936-37.....	107	346	772	908	847	865	941	557	176	21	5540
1937-38.....	127	417	639	1026	1131	928	770	470	257	40	5805
1938-39.....	109	270	575	954	1141	888	943	589	229	40	5738
1939-40.....	84	359	748	963	1313	1010	986	617	262	58	6400
1940-41.....	106	454	659	916	1195	974	960	376	175	46	5861

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DEGREE DAYS (65F BASE) FOR RECENT HEATING SEASONS

Heating Season	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Total
READING, PA.											
1936-37.....	59	278	707	818	813	862	857	455	99	1	4949
1937-38.....	101	358	605	946	1018	818	606	345	153	13	4963
1938-39.....	89	244	561	917	992	767	769	491	127	9	4966
1939-40.....	43	314	642	882	1287	927	907	528	141	16	5687
1940-41.....	95	421	630	833	1088	982	911	258	105	24	5347
RICHMOND, VA.											
1936-37.....	13	157	529	730	573	722	632	273	49	—	3678
1937-38.....	58	298	515	780	828	566	380	207	84	8	3724
1938-39.....	31	198	409	747	697	548	502	283	101	—	3516
1939-40.....	3	214	550	737	1172	726	634	343	78	1	4458
1940-41.....	62	237	467	640	871	806	715	192	63	8	4061
ROCHESTER, N. Y.											
1936-37.....	106	402	903	951	988	1002	1135	604	228	23	6342
1937-38.....	196	511	747	1140	1250	994	763	530	256	25	6412
1938-39.....	176	348	669	1032	1208	1055	1047	687	211	33	6466
1939-40.....	117	413	816	1031	1444	1170	1165	676	243	66	7141
1940-41.....	136	551	781	1061	1309	1189	1232	468	254	42	7023
ST. LOUIS, MO.											
1936-37.....	31	233	645	793	1064	880	735	323	64	6	4774
1937-38.....	47	289	689	1025	976	636	358	269	85	—	4374
1938-39.....	36	116	515	884	760	858	542	378	45	1	4135
1939-40.....	16	183	587	795	1479	899	672	349	111	—	5091
1940-41.....	42	82	628	780	920	904	748	186	29	3	4322
SAN FRANCISCO, CALIF.											
1936-37.....	104	111	210	417	666	421	315	314	244	124	2926
1937-38.....	134	92	203	319	419	335	381	302	263	226	2674
1938-39.....	126	118	248	356	404	385	382	284	246	213	2762
1939-40.....	81	119	173	300	383	280	236	221	213	178	2184
1940-41.....	36	116	239	292	340	269	207	277	151	154	2081
SCRANTON, PA.											
1936-37.....	90	390	825	946	919	968	1044	548	170	3	5903
1937-38.....	173	459	707	1083	1154	950	720	445	221	30	5942
1938-39.....	157	335	663	1023	1150	907	919	582	165	12	5913
1939-40.....	100	424	796	1033	1387	1068	1063	633	205	57	6766
1940-41.....	159	526	734	970	1227	1105	1075	332	190	49	6367
SEATTLE, WASH.											
1936-37.....	165	280	567	652	1032	659	499	476	253	89	4672
1937-38.....	136	258	488	620	699	573	573	348	239	96	4030
1938-39.....	64	310	590	649	629	683	578	342	239	163	4247
1939-40.....	129	338	418	544	608	525	443	327	147	57	3536
1940-41.....	60	246	609	574	593	469	367	296	240	94	3548
SPOKANE, WASH.											
1936-37.....	185	401	980	994	1708	1017	704	550	244	115	6898
1937-38.....	138	386	738	958	1038	878	740	455	273	72	5676
1938-39.....	56	430	898	998	937	1036	735	409	204	171	5874
1939-40.....	118	481	762	868	1089	845	613	435	166	41	5418
1940-41.....	81	376	983	967	1023	746	601	397	293	115	5582
SYRACUSE, N. Y.											
1936-37.....	120	386	864	987	970	990	1123	586	199	21	6246
1937-38.....	187	471	704	1123	1241	991	775	502	249	25	6268
1938-39.....	199	349	664	1042	1218	1031	1051	658	197	25	6434
1939-40.....	118	414	851	1076	1483	1179	1169	688	237	64	7279
1940-41.....	177	555	774	1075	1316	1212	1199	453	263	50	7074
TOLEDO, OHIO											
1936-37.....	85	381	848	972	1046	1011	1021	556	202	30	6152
1937-38.....	161	480	782	1153	1187	898	667	471	201	23	6023
1938-39.....	101	300	638	1056	1078	1008	910	607	157	23	5878
1939-40.....	75	358	733	961	1479	1079	1077	627	281	28	6698
1940-41.....	124	343	789	964	1168	1097	1044	380	141	23	6073
TRENTON, N. J.											
1936-37.....	52	282	716	842	784	852	878	453	100	7	4966
1937-38.....	105	354	608	959	1018	824	653	366	173	17	5077
1938-39.....	74	241	563	907	1025	763	790	485	134	4	4986
1939-40.....	39	313	681	899	1285	932	915	554	149	20	5787
1940-41.....	86	408	618	821	1098	968	915	274	114	29	5331
UTICA, N. Y.											
1936-37.....	126	420	879	1067	1035	1053	1107	635	216	—	6538
1937-38.....	208	477	768	1228	1394	1118	952	515	288	54	7002
1938-39.....	233	372	774	1152	1287	1147	1168	698	197	36	7064
1939-40.....	115	441	897	1224	1620	1295	1242	720	224	77	7855
1940-41.....	193	574	823	1123	1421	1274	1215	403	258	77	7361
WASHINGTON, D. C.											
1936-37.....	26	202	609	779	657	797	711	355	71	—	4207
1937-38.....	78	313	550	866	905	675	478	274	118	6	4263
1938-39.....	43	215	474	825	842	634	589	366	110	1	4099
1939-40.....	13	255	572	772	1244	811	753	426	95	6	4947
1940-41.....	61	300	510	682	936	871	779	204	89	8	4440

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WASHINGTON NEWS

summarized by Loring F. Overman.
Boiler manufacturers meet on price.
Price stabilization on fin coils.
Housing situation being clarified.

HARDLY more than a year or so ago Americans were prone to smile indulgently at news reports of Hitlerian "Guns instead of butter" edicts.

Today, on the inner walls of temporary buildings springing up like mushrooms along Washington's hitherto park-like Mall, appear series of bold motto cards bearing the following wordings: "Will it make more TANKS? Will it make more GUNS? Will it make more PLANES? Will it make more SHIPS?"

By this monotonous but striking repetition, the mottoes pattern the thinking of hundreds of minor executives and thousands of office workers summoned to the Nation's capital by the Office of Production Management and its satellites to administer a "guns or butter" program which daily becomes more complex.

The increasing complexity of the problem originated with the premise that America could have its guns and its butter too. During early stages of the armament program neither Government nor Industry appeared to recognize this premise as fallacious, with the result that half a dozen inadequate drafts of a Defense Program have had to be revised, enlarged, or discarded entirely.

There are indications in Washington that certain phases of the Defense program have again reached an impasse that can be broken only when both Government and Industry will accept "Will it make more guns?" as a national motto—let the chips fall where they may.

As 1941 draws to a close it would appear timely to trace a brief summary of the year, as revealed in HEATING and VENTILATING's Washington news columns. At the turn of the year readers were concluding chapters of a five-month series of articles on "How to Get Defense Business." Spring brought the distant threat of Priorities — but with little indication they would affect the heating and ventilating industry from top to bottom.

Mid-summer and early Fall brought the realization that there might be something to the flying rumors of possible material shortages, and by November the industry itself — endeavoring to forestall the possibility of even more drastic cuts—had suggested a voluntary reduction of from 35% to 50% in total production. That this proposal had not, at press time, been acted upon by OPM, may indicate that the guns or butter program has reached another of the slowed-down stages inevitably preceding some major new development.

Further supporting this conclusion is the month of relative inactivity that has followed the November appointment of a plumbing and heating industry committee. Other than a preliminary meeting of the industry's steering committee on November 6th and a tentative draft of a revised plumbing and heating code (now stymied in legal departments) there appears to be little to report from the office of Leighton H. Peebles, chief of the Plumbing and Heating Branch, Office of Civilian Supply.

It should not be assumed, however, that the newly designated OCS branch has itself been inactive. Organization and personnel of the branch are now nearing completion, new quarters have been assigned in one of the many temporary buildings, and the Branch is taking constructive action on the many preliminary plans in its files.

Regarded as almost a sure sign that the will-it-make-more-guns motto is to take precedence over all others is the rumored pending resignation of the head of the OPM Division of Contract Distribution — assigned the task of protecting small business from the strangling effects of priorities. While the on-paper plan of the Division of Contract Distribution has been regarded as a model of efficient organization, it has been relatively unsuccessful in actually distributing contracts among manufacturers threatened with annihilation.

Still one of the knottiest problems of the Administration is that of delivering guns without ruthlessly taking the butter out of the mouths of thousands of small manufacturing plants, as well as that of their employees.

Allocations vs. Priorities

That the solution may lie in replacement of the priorities system with an all-out allocation plan is the hope of the Supplies Priorities and Allocations Board, the seven-man OPM "cabinet," headed by Vice-President Henry A. Wallace. Announced in mid-November by SPAB, the allocations program means that the Government will allocate specific amounts of all critical manufacturing supplies to every major industry.

This revolutionary policy, long anticipated as the only answer to the increasing difficulties of the priorities method, makes for absolute Government control of the nation's manufacturing economy during the emergency period, according to close observers.

Since the transition to an allocations system requires a long period of time, informed Washington sources do not look for the operation of a system for several months. In the meantime, priorities ratings previously announced will stand, and all the mechanics previously required to secure scarce materials remain operative. In announcing the proposed allocations program, SPAB and OPM explained its operation as follows:

1. Donald Nelson, Executive Director of SPAB, is authorized to obtain a detailed production program of every civilian and military industry and essential public service in the nation, industry by industry, and showing month to month materials requirements for 1942;

2. Various branches of the OPM will work up the programs of all industries under their jurisdiction, showing the requirements per unit of production;

3. Concurrently, under previous SPAB orders, similar requirements programs are being worked up for the Army, Navy, Maritime Commission, Lend-lease and other military needs;

4. Following the preparation of the requirements program, they will be brought to the OPM industrial branches, which have the data on quantities of raw materials available for distribution. Then, after deducting the amount of materials which must go to military needs, agreement will be reached on how much is left over to be allocated to the civilian economy and how much to each industry in the economy; and

5. When the program for a certain industry is agreed upon, it will be submitted to SPAB for approval. SPAB then may approve, modify, or order other action.

The approved program will then be transmitted to the OPM, Priorities Division, which will issue orders allocating materials to each industry, or giving high ratings with frozen delivery dates so that military needs will be forthcoming.

While the allocations plan has been given the SPAB green light, Defense

officials, who have seen plan after plan outgrown by the armament program itself, are planning to "make haste slowly" in putting the edict into effect. Perhaps the posting of the previously mentioned mottoes is a first step in steeling all concerned for the decisions that will be necessary. These decisions, as explained by A. J. Browning, special assistant to Priorities Director Nelson, may require a high degree of assurance and fortitude.

"More than two months ago," said Mr. Browning, "Mr. Nelson called me to Washington and asked me to see if we could work **out** a plan whereby we would simply **allocate** a certain portion of all of the critical materials to build up a pool, out of which we could make pro rata allotments to all small manufacturing firms coming under a given size limit. I have been working on that assignment ever since—and it just can't be done.

"In the first place we don't have enough materials. There are over 180,000 manufacturing establishments in the country. Probably upwards of 100,000 of them are classed as small plants—and by small I mean plants that have around a score of employees, or fewer. Now each one of these plants might need only a comparatively small quantity of materials; but in the aggregate the amount required to keep all of them going would be tremendous.

"These shortages are very, very acute and with the best will in the world we cannot promise that everyone will be taken care of. We are going to have to be selective. And in being selective we cannot simply make size of the plant the sole consideration. After all, the worker who loses his job because his plant closes will be in just as bad a fix if he is one of 30 employees as if he is one of 15; the capital of the factory owner will evaporate just as surely if the plant that gets closed employs 100 men as it will if the plant employs only a dozen.

"You cannot draw a horizontal line anywhere through our economy and guarantee that you will save everybody under it. The best you can do is determine that in making allocations and in making curtailments you will be guided by the ruling motive that the greatest number of people must be employed and the smallest number of businesses injured. This motive is being and will be followed in the handling of this whole allocation and curtailment program.

"Now there is another angle to this problem that deserves attention. I think the manufacturer, be he large or small, does neither himself nor his country any service if he assumes that his only hope of escape from these shortages is through Government help. There are two big factors in the manufacturer's favor.

"First is the fact that our defense requirements are becoming so huge that before we get through we are going to need the services of every shop and factory that can possibly turn out military items.

"The second favorable factor is the pressure of increased civilian buying power. That pressure, of course, is what is causing these shortages; and because of shortages we have got to strip our productive machinery down to essentials, cut out the frills, and in general confine ourselves to the production of the things the Nation really needs. The point I am trying to make is that it may be just as important for the man who is producing less essential goods to convert his plant to the production of essential goods, or goods that do not use critical materials, as it is to convert to the production of military goods. The man who can make such a shift most certainly increases his own chance of survival."

Building Substitutes

In line with Mr. Browning's plea that all users of raw materials give consideration to simplification and the substitution of materials not regarded as critical, Public Buildings Administration is using this idea as a yardstick in planning its building program for 1942.

PBA is now reported to be in a quiet period — between appropriations and pending the outcome of current shakeups in the housing setup — and is directing the attention of its staff to experimentation with many types of substitute materials and construction methods.

With the expected release of the new $300,000,000 defense housing appropriation, PBA is planning to make wide use of mass purchase methods of acquiring heating equipment, plumbing and other housing incidentals. Preliminary forays into mass purchasing were highly successful, it is reported, resulting in the decision to extend this type of buying in future PBA programs.

Fleming Succeeds Carmody

Appointment of Brig. Gen. Philip B. Fleming, former Wage-Hour Administrator, as head of Federal Works Administration, succeeding Administrator John M. Carmody, settles one phase of a housing controversy involving all Washington agencies handling housing. Mr. Carmody is transferred to the Maritime Commission under the new setup; Defense Housing Coordinator Charles F. Palmer appears to be slated to continue in his present position, and an early settlement of USHA charges of duplicated effort is anticipated.

Price Stabilizing

A price stabilization order to be issued about December 10, covering heating and refrigerating coils and allied equipment, is being completed by the Office of Price Administration. Text of the Order and a list of affected items was read and discussed at a meeting of 22 called representatives of the industry on November 24 at Washington.

The new order will fix the maximum prices of the specified equipment at a point equal to prices in effect during the period between September 22 and October 21, 1941, according to E. A. Ledwith, chief, mechanical equipment unit of the lumber and building materials section, Office of Price Administration. Affected by the ruling will be finned coils, water heaters, radiators and convectors, unit heaters, coolers and air-conditioners and heat exchangers.

While the OPM copper curtailment order is directly responsible for action by OPA to prevent further price increases in this field, the new order will cover a number of products not made of copper. This is considered necessary because such products either are competitive with similar items made of copper or brass, or are in the nature of substitutes. Hence, OPA finds, prices of all are subject to the same pressure for increase arising out of the copper limitation order.

A similar order covering low pressure boilers is expected to result from a meeting called for December 3 by Administrator Leon Henderson, Office of Price Administration. Manufacturers of all types of low pressure boilers made of iron and steel, whether fired by coal, gas or oil, were invited to attend the meeting to discuss recent price increases and to suggest means of stabilizing future prices.

Housing Restrictions Explained

SPAB's Executive Director, Donald Nelson, has emphasized recently that the order against construction of non-defense buildings does not prohibit all types of non-defense construction, but only that involving strategic materials. Mr. Nelson explains that building and housing of all types may proceed if strategic materials are not involved or where substitutes may be employed.

OPM's Research Division estimates that 1942 construction totals will be the largest of any year since 1930 with the exception of the present period, in spite of SPAB control of building activities. OPM expects an increasing shift to defense construction with a total defense building total estimated to reach $15 billion by 1943.

Army Construction Changes

A bill passed by both Houses of Congress and awaiting the President's signature authorized the transfer of all construction activities of the Army from the Quartermaster Corps to the Corps of Engineers.

ABSTRACTS of Current Papers, Books and Pamphlets

Pressure Type Oil Burners

A bulletin by two research professors of mechanical engineering at the Iowa Engineering Experiment Station, and containing a report of tests, their analyses and conclusions on performance of pressure type oil burners with particular reference to burner make, boiler type (whether conversion or oil design), firebrick composition and cycling rate. Following are the conclusions of the authors:

1. The maximum difference in fuel economy obtained with the four high-pressure oil burners tested was about 15%. The more economical burners, installed in the tight-fitting boilers, were able to maintain from 10 to 12% CO_2 in the stack gases without smoke;

2. Reducing the excess air (increasing the CO_2 in the stack gases) caused a higher combustion-chamber temperature and a lower stack temperature, and resulted in a higher efficiency;

3. The effect of cycling rate upon fuel economy was not great. There was no one cycling rate which was most efficient for all burners and boilers;

4. About 21% more fuel oil was required to furnish the same amount of heat with the general-purpose conversion boiler than with the oil-designed boiler, chiefly because of higher stack temperatures with the conversion boiler;

5. The efficiency of the conversion boiler was increased by baffling its large flue passages with firebrick;

6. The least efficient burner operated more economically in the oil-designed boiler than the most efficient burner in the conversion boiler;

7. Three of the four burners tested operated most efficiently with the lowest nozzle capacity able to deliver the required output. However, the difference in efficiency was slight, so that the larger nozzle sizes sometimes may be preferable because of their ability to supply heat at a more rapid rate;

8. From 3 to 7% less fuel oil was required when the combustion chamber was constructed with insulating firebrick than when it was constructed with standard firebrick. A considerable part of this saving was the result of the reduced heat loss through the insulating brick;

9. The influence of combustion-chamber dimensions upon efficiency was not great, but the best efficiency for each burner was obtained with a chamber having dimensions which approximated those recommended by the burner manufacturer;

10. The relative fuel cost when heating with oil or coal varied with the type of boiler used, the kind of coal fired, and the method of firing. The following cost comparisons were found for fuel prices existing locally in the winter of 1941, when fuel oil had a retail price of 6.9 cents per gal:

a. Fuel cost with oil burned in the conversion boiler was about 80% more than with Iowa coal, at $5 per ton, stoker-fired in the same boiler.

b. Fuel cost with oil burned in the conversion boiler was approximately 60% more than with Illinois, Indiana, or Western Kentucky coal, at $7.50 per ton, stoker-fired in the same boiler.

c. Fuel cost with oil burner in the conversion boiler was about 60% more than with Iowa coal, at $5 per ton, hand-fired in a somewhat similar type of boiler.

d. Fuel cost with oil burned in the conversion boiler was about 10% less than with a high-grade Eastern coal, at $11 per ton, hand-fired in a similar type of boiler.

e. Fuel cost with oil burned in an oil-designed boiler was about 24% less than with a high-grade Eastern coal, at $11 per ton, hand-fired in a general-purpose boiler.

Relative costs with other price conditions are indicated by curves in the text. The cost comparisons do not consider the initial cost of the equipment or the greater convenience of an oil-burning heating plant.

[*"Performance of Pressure-Type Oil Burners," by M. P. Cleghorn and R. J. Helfinstine. Bulletin 151, 1941. Published by the Iowa Engineering Experiment Station, Iowa State College, Ames, Iowa. 6 x 9 in.; paper cover; 32 pages.*]

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Active Carbon

The fourth edition of this book, first issued in 1930 and dealing primarily with the so-called decolorizing types of active carbon. The book is divided into six general divisions. The first division is a general approach describing what active carbon will accomplish and how it is used; the second is a detailed description of the application to various products; a third division reviews basic principles, while a fourth discusses methods of evaluation. A feature of the book is the fifth division which is a bibliography of literature on adsorption as related to active carbon.

Since the cost of this publication has been assumed by the manufacturers of Nuchar Active Carbon with the frank objective of promoting the use of this product, a final division describes the qualities of the company's active carbon and their application to the various products discussed in the technical section of the book. Chapter X is devoted to the use of active carbon in connection with air conditioning, principally the removal of odors and also the removal of fumes from such substances as mercury. Also mentioned are applications of active carbon to adsorb vapor emanating from over-ripe fruit and which causes the too early ripening of other fruit in the same space, and use of active carbon to adsorb sulphur from the air to prevent tarnishing of silver in jewelry stores.

[*"Active Carbon—The Modern Purifier," by John W. Hassler. Published by Industrial Chemical Sales Division, West Virginia Pulp and Paper Company, 230 Park Ave., New York. Cloth bound; 6 x 9 in.; 159 pages.*]

Building Insulation

If there is anything about building insulation that a heating or air conditioning engineer would want to know that is not covered in Paul D. Close's book on the subject, this reviewer would not know what it would be. In addition to building insulation itself, the author has included very interesting chapters on piping and duct insulation, sound insulation, machinery isolation and architectural acoustics.

The chapter describing and listing the various types of thermal building insulations is by far the most complete ever made generally available. It includes a list tabulated alphabetically by trade name which makes it particularly valuable. Other chapters include methods of application; fundamentals of heat transfer through building materials; transmission coefficients and tables; information on calculating heat losses; fuel saving; economics of insulation, and a very nicely prepared chapter on condensation.

The book concludes with questions relating to each chapter, presumably with the idea of making the book suitable for textbook use. Altogether the book is comprehensive, well arranged, and one to be highly recommended.

[*"Building Insulation," by Paul D. Close. Published by the American Technical Society, Chicago, Ill. Cloth cover; 5½ x 8½ in; 328 pages. Price, $3.*]

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Housing for Health

This volume is the first collected series of papers of the Committee on the Hygiene of Housing, and presents the findings of several years of research by this branch of the American Public Health Association in those aspects of housing design, construction, and occupancy which influence physical, mental, and social health.

The primary purpose in issuing the volume has been to make the results of solid investigative work in these directions available, in not too technical form, to professional persons and agencies in the interrelated fields of public health and housing, and to a broad range of laymen, students, and teachers with a serious interest in these fields. The book should help fill the gap in housing literature between the uncritical output of housing propagandists on the one hand, and the technical reports of highly specialized research agencies on the other.

Of particular interest to heating engineers is the section on "Heating, Lighting, and Noise Conditions in Recent Housing Projects," by Allen A. Twichell, technical secretary of the Committee on the Hygiene of Housing, and the section of "Heating and Ventilating of the Home," by Dr. C.-E. A. Winslow.

Dr. Winslow's section is a reprint of the paper he presented at the Yale-Life Conference on House Building Technics, at New Haven in 1939.

Mr. Twichell's chapter is a preliminary report on a field study of the Committee on the Hygiene of Housing which includes a very nicely prepared summary of the reason for heating and cooling, together with information on the Committee's survey. Of particular interest is the inclusion of the term operative temperature in this Committee's report which is defined as the mean between the air temperature and mean radiant temperature of the walls.

[*"Housing for Health." Planned and edited by Allen A. Twichell, Technical Secretary of the Committee on the Hygiene of Housing, of The American Public Health Association. Paper bound; 6 x 9 in.; 221 pages. Price, $1.00. Available from the Committee at 310 Cedar Street, New Haven, Conn.*]

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Sawdust Burners

Professor E. C. Willey of Oregon State College is the author of a bulletin just published by that institution entitled Rating and Care of Domestic Sawdust Burners. The booklet mentions that during the past five years small domestic equipment has been developed commercially for burning sawdust for heating plants and that these are being rather widely used in Oregon and Washington. The author has assembled in concise form considerable and interesting information regarding the availability of sawdust in that region together with data on the heat values of sawdust from various trees.

Photographs and descriptions of typical sawdust burning units now on the market and which do not differ from each other essentially appear in the pamphlet, followed by information on rating of these units, a subject on which the author first began to work as early as 1928.

The most important part of this publication is the report of results of tests run by Professor Willey on these units. These results have been summarized in conclusions which include his formula for calculating sawdust burner capacity. The text closes with a section on the correcting of sawdust burner troubles.

[*"Rating and Care of Domestic Sawdust Burners," by Prof. E. C. Willey. Bulletin Series, No. 15, July, 1941. Published by Engineering Experiment Station, Oregon State College, Corvallis, Ore. Paper cover; 6 x 9 in.; 27 pages. Price, 25 cents.*]

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BRIEF REVIEWS

Occupational Diseases. A report describing a survey made by the United States Public Health Service in Utah to evaluate the various factors bearing on the health of Utah workers so that the information resulting could be used in enacting legislation on industrial health hazards and, also based on this survey, summarizing what the responsibilities and opportunities confronting public health administrators are with respect to legislation. [*"The Public Health Administrator's Responsibility in the Field of Occupational Disease Legislation," by J. J. Bloomfield and W. M. Gafafer. Published in Public Health Reports, Vol. 56, No. 42, October 17, 1941. 9 pages.*]

Air Conditioning and Disease. Paper reprinted from *Industrial Medicine* and giving a brief discussion of infection, disinfection, and air conditioning. [*"Infection, Disinfection and Air Conditioning," by William Firth Wells. Reprinted from the July, 1941, issue of Industrial Medicine, Vol. 10, No. 7.*]

FUEL OIL. A survey of the gasoline and fuel oil situation in New York prepared by Grover A. Whalen and submitted to Mayor LaGuardia, Chairman of the City Defense Council.

Included in the report is a section on fuel oil which states that sales of light fuel in the city of New York are in 1940 estimated to have totaled 333,000,000 gallons while sales of heavy fuel oil were 420,000,000 gallons of which probably 250,000 gallons were used for heating purposes. It was indicated that the demand for light fuel oil in 1941 is estimated to exceed last year's requirements by approximately 5%.

Savings in light fuel oil which can be effected in New York City by home owners are estimated in the survey to be 20,000,000 gallons, half of which would result from a more careful control of inside temperatures. The other half would be made up in equal measurement by improving the efficiency of boiler plants and by insulating homes.

A survey by the Real Estate Board of New York indicated that buildings which changed from coal to oil since last year will use about 329,000 gallons of oil. On the other hand, to offset this some plants that had burned oil will this season use street steam and the gallonage saved here is estimated at 423,000 gallons.

The New York Steam Company reports that it has closed contracts to supply steam to 10 buildings and that the saving by this change will be about 4,500,000 gallons of fuel oil. This figure includes the half million gallons reported by the Real Estate Board.

The survey recommends that consideration be given to the possibility of converting plants from oil burning to the use of coal or street steam. [*"The City of New York Gasoline and Fuel Oil Survey," by Grover A. Whalen. 8½ x 11 in. Paper cover. 67 pages.*]

MINE CONDITIONING. A report of the Bureau of Mines on the effect of changes in moisture and temperature on mine roofs. The results of investigations of causes of mine roof disintegration. Investigation included an attempt to study the effect of air conditioning on mines but the results of this phase of the investigation proved disappointing as investigators report they were able to find no factual data to support or oppose any claims regarding the desirability of air conditioning to prevent roof disintegration in mines. [*"Effect of Changes in Moisture and Temperatures on Mine Roof—First Report on Strata Overlying the Pittsburgh Coal Bed," by Irving Hartmann and H. P. Greenwald, 40 mimeographed sheets published by Bureau of Mines. Report of Investigations No. 3588, October, 1941.*]

WATER MEASUREMENT. A code for measuring water prepared by the Standards Committee of the Hydraulic Institute assisted by the University of California engineering department. Intended for all manufacturers of deep well turbine pumps as a guide for measurement of capacity in the field. Includes numerous fold-in charts and curves. [*"Code for Measurement of Water Using Standard ISA Orifices With Free Discharge." Published by Hydraulic Institute. 22 pages; 8½ x 11 in.; paper cover. Price, $1.*]

BOILER GUIDE. The second of a series of folders for domestic fuel users. Intended to give the coal user a better idea of what it is all about, to sell the idea of boiler cleaning, repair, modernization, and replacement, giving the heating system some of the same attention that is being given automobiles, and to establish the fact that what a customer gets out of the fuel he buys depends largely on the maintenance and operation of the heating equipment he uses, and to some extent, on building and heating construction. The folders cover the various factors that affect heating comfort, what happens to the heat the customer buys, the advantages of new equipment, insulation, storm windows, weather stripping, insulation of pipes, the advantages of new radiator vents, firing methods, heating costs, degree-days, and various pointers on heating—all explained in words that any home owner could understand, briefly, yet authoritatively. [*"Boiler Heating Guide," by K. C. Richmond, Editor, Coal-Heat. 3⅞ x 8¾ in.; 24 pages. Sample copies from Coal-Heat, 20 West Jackson Blvd., Chicago, at 10 cents each; in lots of 100 or more, at 5 cents each; and in lots of 1000 or more, at 4 cents each.*]

COMPRESSED AIR. The fifth edition of the Compressed Air Institute's Trade Standards containing a wealth of technical information on rotary compressors and vacuum pumps, centrifugal compressors and blowers, compressor accessories, rock drills and pneumatic tools, and reciprocating compressors. Chapter headings include definitions; nomenclature and terminology; rating standards and guarantees; test standards; installation and care of compressors; lubrication; data; some uses of compressed air; reciprocating compressors and vacuum pumps, stationary type; rotary compressors and vacuum pumps; centrifugal compressors and exhausters; compressor accessories; portable compressors; rock drills and accessories; and pneumatic tools and accessories. [*"Trade Standards" Adopted by Compressed Air Institute, 90 West Street, New York, N. Y. Paper cover; 8½ x 11 in; 110 pages. Price, $1 plus postage.*]

HOUSING. This book is one of a series of booklets from the Consumer Purchases Study presenting facts concerning incomes and consumption patterns of families in small villages and on farms. The booklet covers the following five regions: New England, Middle Atlantic and North Central, Mountains and Plains, Pacific, and Southeast. Included is information on heating facilities by central furnaces and by stoves and fireplaces. Of interest to those concerned with the rural market for heating appliances. [*"Family Housing and Facilities"—Consumer Purchases Study—Miscellaneous Publication No. 399. Published by the U. S. Department of Agriculture. Paper cover; 6 x 9 in.; 223 pages.*]

INSTALMENT SELLING. A pamphlet published by the Public Affairs Committee on instalment selling giving both sides of the argument but justifying the restrictions on instalment selling put into effect early this fall. [*"Instalment Selling—Pros and Cons," by William Trufant Foster. Published by the Public Affairs Committee, Inc., 50 Rockefeller Plaza, New York. Paper cover; 5¼ x 8¼ in.; 32 pages. Price, 10 cents.*]

BOILER FEEDING. The wining essay in the Hydraulic Institute's first annual engineering essay contest held last year, the author of which is an application engineer in the centrifugal pump sales division of the Worthington Pump and Machinery Corp. Covers the thermodynamics of boiler feeding, with the following sub-divisions: Description of feed cycles in general; discussion of pumping power and mechanical problems with relation to feed water temperature; analysis of temperature rise in boiler feed pumps; thermodynamic efficiency of boiler feed pumps; disposal of bypass and leak-offs; and discussion of minimum permissible capacities. Includes 18 diagrams. [*"Thermodynamics of Boiler Feeding," by Igor J. Karassik. Published by the Hydraulic Institute, 90 West Street, N. Y. Paper cover; 8½ x 11 in; 39 pages. Price, 50 cents.*]

CONDENSATION. A comprehensive report on a 3-year study of condensation in building construction conducted at the University of Minnesota and largely financed by the National Mineral Wool Association. The research demonstrated that houses can be safely constructed with full thickness mineral wool insulation using a moisture vapor barrier and with provision for adequate attic ventilation, and that insulation can be installed in existing houses to the full thickness of the stud space without any danger, provided that intelligent control of interior relative humidity is exercised. [*"Condensation of Moisture and Its Relation to Building Construction and Operation, Bulletin 18," of the Engineering Experiment Station, University of Minnesota, Minneapolis, Minn. By F. B. Rowley, A. B. Algren, and C. E. Lund. Size 6 x 9 in.; 70 pages. Price, 40 cents.*]

AIR POLLUTION. The 1941 Manual of the Smoke Prevention Association of America, Inc., containing in its 176 pages the proceedings of the 35th annual convention of the Association, together with miscellaneous information on the correct way to fire and maintain boilers; and information on smoke abatement activities in various cities. [*"Manual of Ordnances and Requirements." Published by the Smoke Prevention Association of America, Inc. Paper cover; 176 pages; 6 x 9 in. Price, 60 cents.*]

ADVERTISING. The keynote address delivered to the National Industrial Advertisers Association by Horace T. Hunter, president of The MacLean Publishing Company of Toronto, and emphasizing the importance of advertising during War times even though the advertiser has more business than he can handle currently. [*"Industrial Advertising in a War Economy," by Horace T. Hunter. Paper cover; 4½ x 7½ in.; 22 pages.*]

DIRECTORY. The thirty-first annual edition of the ASME Mechanical Catalog and Directory. Includes a section on technical catalog-type advertisements as well as a comprehensive directory of mechanical engineering equipment and associated trade names. [*"ASME Mechanical Catalog and Directory." Published by the American Society of Mechanical Engineers, 29 West 39th St., New York. Cloth bound. 8½ x 11½ in. 437 pages.*]

WELDING. This concise arc welding book, written in easy-to-understand English, offers students, instructors, engineers, and executives an abundance of practical arc welding data and lessons. Patterned after the course of lessons offered in the Hobart Trade School, this book leads the student easily throughout all the fundamental stages of arc welding. Forty-two complete arc welding lessons are covered in the book. [*Practical Lessons in Arc Welding," by W. J. Chaffee. 100 pages. 77 illustrations. Paper cover. Published by Hobart Brothers Co., Troy, Ohio. Third edition in seventh printing. Price, 50 cents. Special edition in Spanish $2.*]

GAS STATISTICS. Two bulletins covering the 1940 statistics of the natural and manufactured gas industries and including such information as the number of gas customers, gas sales and revenues from the sale of gas. [*"Annual Statistics of The Natural Gas Industry in 1940," Statistical Bulletin No. 45, October, 1941, and "Annual Statistics of the Manufactured Gas Industry in 1940," Statistical Bulletin No. 44, October, 1941. Published by the American Gas Association, 420 Lexington Ave., New York. Both paper cover; 8½ x 11 in. Bulletin No. 45 has 15 pages, Bulletin No. 44, 25 pages.*]

ADVERTISING. A research bulletin of the National Better Business Bureau, Inc., giving information for advertising managers and writers on points to be observed in making reference to the Army and Navy in advertising. [*"Reference to the Army and Navy in Advertising." Published by the National Better Business Bureau, Inc., 405 Lexington Avenue, New York, N. Y. Mimeographed; 5 pages; 8½ x 11 in. Price, 3 cents.*]

WATER TREATMENT. A study of one form of chlorine compounds used as deodorizing and germicidal agents. Booklet includes a report on investigations conducted on the efficacy of the solutions together with an appendix of tabulated data. [*"Factors Affecting the Germicidal Efficiency of Hypochlorite Solutions," by A. S. Rudolph and Max Levine. Bulletin 150, 1941. Published by The Iowa Engineering Experiment Station, Iowa State College, Ames, Ia.*]

AIR CONDITIONING AND DISEASE. A paper discussing the relationship of air conditioning to respiratory disease infections and distinguishing among the functions of different types of ventilation and air conditioning and their relation to this type of application. [*"Diseases of Respiratory Tract and Air Conditioning," by Carey P. McCord. Published in the Journal of the American Medical Association, 535 N. Dearborn St., Chicago, March 29, 1941.*]

OIL MARKETING. A mimeographed mineral industry survey of the Bureau of Mines covering fuel oil and kerosene sales in 1940 and showing that fuel oil continued its upward trend during that year. [*"Fuel Oil and Kerosene Sales Continue Upward Trend in 1940," Mineral Market Report, No. MMS 941, Mineral Industry Surveys. Published by the Bureau of Mines. 21 mimeographed sheets.*]

NEWS OF THE MONTH

Cast Iron and Non-Ferrous Convectors May be Standardized, Joint Convector Code Committee Announces

CHICAGO—To protect the interests of the public as well as the industry, and to conserve critical defense materials, manufacturers of cast-iron and non-ferrous convectors have adopted a Proposed Code for the Testing and Rating of Convectors. The code was formulated by a Joint Convector Code Committee and accepted by engineers representing the various manufacturers. At the present time manufacturers are running tests to determine if the code is adequate. Following the termination of the tests in December it is planned to request the National Bureau of Standards to incorporate the code in a commercial standard.

The code is designed to serve the purpose of solving problems which have existed over a long period in connection with determining the output of convectors, both cast-iron and non-ferrous, according to R. E. Ferry, secretary of the Joint Convector Code Committee.

These problems have existed because of several factors, among the most important of which are:

1. Engineers have not reached an agreement as to whether convector output or rating should be determined strictly on condensation and water heat capacity only, or whether other factors should also be considered;

2. The need for more precise standards covering the method of test and the laboratory equipment to be used;

3. The multiplicity of design variations which affect output in varying degree; and

4. Lack of uniformity in the policy of specifying agents (government departments and others), as to accepting or discounting published catalog ratings.

Because of the direct interest of a large number of federal government departments and agencies in these problems, a meeting of convector manufacturers in May, 1941, was sponsored by the Sub-Committee on Heating and Ventilating of the Central Housing Committee of the Federal Government for the purpose of finding a generally acceptable basis for the solution of the problems involved.

At that meeting, manufacturers of both cast-iron and non-ferrous convectors gave ample evidence of their desire to support a program which would result in proper evaluation of the performance of convectors. A Joint Convector Code Committee was appointed to develop a code for testing and rating convectors, which code would be incorporated at as early a date as possible in a Commercial Standard promulgated by the National Bureau of Standards of the U. S. Department of Commerce.

The members of the Joint Convector Code Committee who have developed this code include two representatives of The Convector Manufacturers Association, R. N. Trane of The Trane Company and A. A. Ahlff of Tuttle and Bailey, Inc.; and two representatives of The Institute of Boiler and Radiator Manufacturers, B. Goerg of the American Radiator and Standard Sanitary Corporation, and L. N. Hunter of the National Radiator Company. Mr. Trane is chairman of the Committee.

In its discussion the Committee had the advice and assistance of R. S. Dill of the National Bureau of Standards and Professor M. K. Fahnestock of the University of Illinois. Both Mr. Dill and Professor Fahnestock are advisory members of the Committee.

Army Post Heating Studied

WASHINGTON—A group of combustion engineers is engaged in laboratories, factories, coal mines and Army posts in an intensive study of the best methods of keeping the Army's approximately 1,500,000 officers and men warm this winter. The engineers, members of a staff organized by the Construction Division, Office of the Quartermaster General, are making the study in a short course sponsored by the repairs and utilities branch of the division.

The course began Monday, November 3, at the factory of the Lennox Furnace Company, Syracuse, New York. There the group discussed forced warm air furnaces.

Then the party went to Fort Ontario, N. Y., November 5, for a study of operating problems which engineers in charge of the instruction had previously set up for them to solve. The Army coach and pupil method was used. Simply stated, it is "learning by doing." On November 7 the Anthracite Institute Combustion Laboratory at Primos, Pennsylvania, demonstrated the research and operating methods being developed there.

The Repairs and Utilities Branch of the Construction Division has charge of heating barracks and other buildings in Army camps and cantonments and of providing facilities for cooking and heating water. The magnitude of the task may be sensed from the fact that these housekeeping needs will require 3,000,000 tons of bituminous coal, 700,000 tons of anthracite, and 26,000,000 cubic feet of gas.

REMA Backs Exhibition in '42

CHICAGO—Voting down a suggestion to suspend the fourth All-Industry Refrigeration and Air Conditioning Exhibition, the board of directors of the Refrigeration Equipment Manufacturers Association has announced definitely that the show will be held in the Stevens Hotel here Jan. 12-15.

The directors declared: "Such industrial expositions are as necessary today as during normal times." Quoting President Roosevelt's recent statement that, "Wherever people congregate, the story of defense must be presented," the board announced that the coming exhibition would show the industry's part both in military defense and in civilian defense.

The directors recognized that this year, because of restrictions and allocations, the show could not be expected to equal its enviable record as "one of the nation's most successful selling shows," but pointed out that the need for bringing together in one place at one time everyone of importance in the industry was greater now than ever before.

It was concluded that the All-Industry show can perform an unusually timely service for refrigeration by dramatizing what it has been doing, now is doing, and can do for the well-being of the citizenry — military as well as civilian.

Davis Addresses Oil Heat Ass'n

BUFFALO—The November meeting of the Oil Heat Association of Western New York was featured by a talk by Walter P. Davis, executive secretary of the Air Conditioning Council of Western New York.

Offering suggestions as to how the Oil Heat Association could improve attendance and interest in its meetings, Mr. Davis recommended that matters of a technical nature be eliminated from proceedings and that discussion be centered on promotional matters.

He further recommended that the Oil Heat Association join with the Air Conditioning Council, the Stoker Association and other heating groups in sponsoring a big public meeting to focus attention on the comforts and economy of automatic heating.

The proposed code for the oil heat trade was briefly discussed and referred to the board of directors. The board subsequently decided that the code question and the matter of price-fixing be eliminated from general meetings henceforth.

G. E. Uhrich of the Buffalo Fire Prevention Bureau spoke briefly on installation requirements under Buffalo's new fire prevention ordinance.

1940 Oil Sales Up 18% Over 1939, Bureau of Mines Reports in Annual Oil Survey and Forecast

WASHINGTON—According to the Bureau of Mines, which has just issued its annual report on oil sales, heating oil sales in 1940 were up 18% over 1939. The report says:

"A 13% gain in the number of domestic and commercial oil burners in use in 1940 and an unusually prolonged cold spell in the first months of the year were both factors which resulted in an 18% gain in sales of heating oils. Fuel oils used for space heating increased from 136,232,000 barrels in 1939 to 160,379,000 in 1940 and the 1940 item constituted over 32% of total deliveries of fuel oil for all uses compared with 30% in 1939. The market for light heating oils (grade 1—4) was most active and distributors reported sales of 115,533,000 barrels or 19% above 1939 requirements of 97,131,000 barrels. Furthermore light heating oils made up 72% of all deliveries of distillate fuel oils in 1940 compared with 70% in 1939. Heavy heating oils (Grades 5 and 6) were likewise in great demand and the volume of sales increased 15% from 39,101,000 barrels in 1939 to 44,846,000 in 1940. In relation to total deliveries of all residual fuel oils, those sold for heating accounted for 12% of the total in 1939 and 13% in 1940.

"Expanded sales of heating oils were general throughout the country, the greatest gains being reported for the North Central and North Atlantic Seaboard areas. Deliveries in the North Central States of 42,728,000 barrels were 16% above the 1939 total of 36,755,000 barrels. New England dealers reported sales of 28,986,000 barrels, about 20% above 1939 requirements of 24,263,000 barrels. A similar percentage gain was made in the Middle Atlantic area, the market increasing from 54,460,000 barrels in 1939 to 65,250,000 in 1940. Sales of heating oils on the Pacific Coast increased 11% from 9,340,000 barrels in 1939 to 10,621,000 in 1940. It is reported that the higher consumption of heating oils on the Pacific Coast in 1940 was not due to severe weather or to a shift from competing fuels, but rather to an increasing population and high residential construction.

"Number 1 heating oils, which are in greatest demand in the North Central States, made up about 11% of total deliveries of light heating oils in both 1939 and 1940. Sales of Number 1 heating grade increased from 10,485,000 barrels in 1939 to 12,533,000 in 1940—a 20% gain. Number 2 heating oils, over 75% of which are sold in the New England and Middle Atlantic States, constituted 64% of total light-heating oil sales in 1939 and 65% in 1940. Deliveries of Number 2 grade in 1940 of 74,854,000 barrels were 21% greater than the 1939 total of 61,856,000 barrels. About 20% of the light fuel-oil demand in both 1939 and 1940 was supplied by Number 3 grade, and over half of the sales of this grade were reported from the North Central States. The 1940 quantity (23,582,000 barrels) was 19% over the 1939 demand of 19,884,000 barrels. Grade 4 fuel oil is no longer carried in official specifications; however, some sales are still reported and these are mostly for the Middle Atlantic States, the volume declining from 4,906,000 barrels in 1939 to 4,564,000 in 1940. Grade 5 heating oil, which comes within the group of heavy or residual fuel oils, is in most demand in the North Central States, although relatively important quantities are also sold in the Pacific Coast and Middle Atlantic regions. Deliveries of 16,904,000 barrels of Number 5 in 1940 were 8% greater than the 1939 total of 15,623,000 barrels. Sales of residual heating oil, Grade 6, which supplies over 60% of the demand for heavy or commercial heating oils, increased from 23,478,000 barrels in 1939 to 27,942,000 in 1940—a 19% gain. About three-quarters of the entire deliveries of this heavier heating oil are limited to the New England and Middle Atlantic States."

Regarding the 1941 possibilities, the report states:

"The unseasonably warm weather along the Atlantic Coast in September and October will probably reduce the 1941 demand for distillate fuel oils to a somewhat lower figure than anticipated several months ago. Present calculations indicate 1941 requirements at approximately 179,000,000 barrels, 11% above the 1940 total. Exports of distillate fuel oil declined about 30% in the first eight months of 1941 compared with the same period of 1940. There may be some improvement in this over-seas trade towards the end of the year.

Boston A.C. Jobs for 1941

BOSTON — Air conditioning installations for the first ten months of the current year are reported by the Air Conditioning Bureau as follows, covering Boston and suburban communities served by the Boston Edison Company: systems over one horsepower, 65 installations with a total connected horsepower of 1,214.

There were also 479 room coolers, totalling 626 hp, making new horsepower air conditioning added total 1,840. This compares with the entire year 1940 as follows: systems over one horsepower, 117; total horsepower, 1,557; room coolers, 424, total horsepower, 294, or 1,851 horsepower for the entire year.

New Products to be Shown at 7th H&V Exposition

NEW YORK — Advance information from exhibitors at the 7th International Heating and Ventilating Exposition indicates many new equipment items will be shown, covering all branches of the field, notwithstanding the deep concentration of many manufacturers on production of standard goods for defense plants. The Exposition, to be held January 26 to 30 in the Commercial Museum, Philadelphia, will be the first of its kind in two years.

A number of manufacturers will devote considerable space to demonstrating the kinds of government work in which they are engaged.

For example, a manufacturer of registers and grilles will exhibit a spark-proof door ventilator, designed for use in bagloading plants, as well as a marine type diffuser used on naval and merchant ships. Another exhibitor will emphasize that automatic heat is vital to defense in civilian homes, in defense homes, in military barracks, on board ships and in defense factories, by the conservation of fuel resources, maintenance of health and increased morale.

Acceptance by the Navy of a special type of grease-trap air filter, used as a safeguard against galley fires, will be stressed by an exhibitor who has found a good demand for this recently developed, readily cleanable filter for installation in range flues.

One exhibit of a boiler manufacturer emphasizes that it can be used for all fuels, and that it incorporates a built-in tankless heater for domestic hot water. The same exhibitor also will show a cabinet type radiant radiator, made entirely of cast iron, eliminating copper for the heating medium and steel for the enclosure. In the same exhibit is also a new low-cost electric steam radiator for auxiliary and special types of heating.

A manufacturer of automatic humidifiers, ventilators, air movers and other equipment for the domestic heating field, will show an all-glass evaporator plate and also offer one of the new synthetic products as a desirable substitute for copper or brass tubing.

Sewell Speaks on Taxes

BOSTON—Henry R. Sewell, vice president of the B. F. Sturtevant Company, and past president of the Air Conditioning Bureau, gave a "Discussion of the Tax Situation With Respect to Air Conditioning Equipment," at the Nov. 27 meeting of the Bureau. Dr. Hermann F. Arendtz, staff economist of the United Business Service, talked of "Business Prospects for the Emergency and Post-War Periods."

Strain and speed are hardest to handle *at the turns* in PIPING, too!

On a bobsled run, constant danger lies at the banked turns. Here the utmost skill of the driver and braker are required to avert an accident. (*I.N.S. photo*).

Insure safer, stronger, trouble-free piping systems with TUBE-TURN welding fittings

When the fluids or gases in your piping systems zoom through the lines and swerve into the turns—*added* strain and friction strike the fittings and joints. Trouble usually develops here *first* in any piping system *because the most danger lies at the turns!*

Weld with TUBE-TURN fittings and *your* plant piping systems will last far longer, function more efficiently and safely, save valuable space, and cut upkeep costs.

There is a TUBE-TURN for *every change in flow direction*—elbows, returns, tees, reducers, laterals, nipples and flanges—made with Tube-Turns' exclusive forging process to give unequalled reinforcement at these danger spots.

Get complete facts in the helpful Tube-Turn engineering data book and catalog. Write today!

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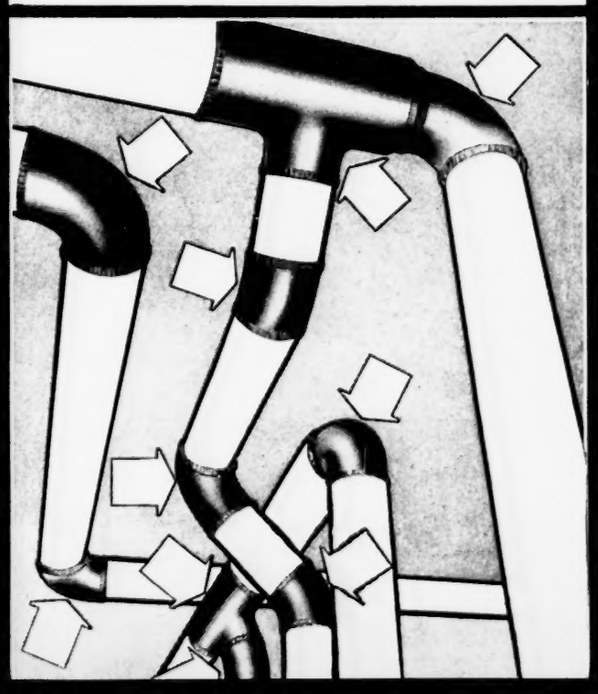
Welding The FIRST WELDING FITTINGS 1ST AND STILL THE BEST *Fittings*

WELDING WITH TUBE-TURNS REMOVES "DANGER AT THE TURNS" IN PIPING

When you think of "turns" in piping systems, remember they occur within tees, reducers, laterals, nipples, heads, etc., as well as within elbows and returns. Wherever there are abrupt *changes in flow direction* you'll find *extra* wear and tear. TUBE-TURN welding fittings provide maximum *extra* strength and safety, and practically eliminate maintenance troubles, at these *danger spots.*



Yedlin Discusses Ship Ventilation at Boston Meeting of ASRE; Steel Plates Used for Ducts

BOSTON—Members of the Boston section, ASRE, on November 14, heard Walter Yedlin of the Bethlehem Shipbuilding Corporation's Fore River Yards at Quincy, Mass., give a talk on ship ventilation and cooling. Practically all modern ships require ventilation and refrigeration, for food supplies at least, and the same general principles of ventilation apply to ships as on shore, he said.

One of the chief problems is interference with the structural design of the ship, which must be at a minimum, in laying out a ventilating and air conditioning system. This is particularly true of vessels used for naval or military purposes, and the naval constructors must be shown the value of air conditioning to improve and speed up operations of personnel, where it is necessary to make a layout that will not interfere in any way with the general structural design.

"However, we are not limited in air velocities in laying out a ventilation system," said Mr. Yedlin. "Ducts on ships may go to rather high velocities, and axial-flow fans are being redeveloped for high pressure and limited space, especially on naval vessels."

For ducts, steel plates are used instead of sheet metal, one reason being that ducts must be watertight up to a certain point, and, on navy ships at least, must have good air and watertight closures. There are problems of the direction of flow. Ducts must not cut through from one compartment to another. Therefore each system or zone must be complete for one particular compartment, and all ducts kept within that compartment—at least, as far as naval units are concerned, and in most cases for merchant vessels.

For fans ventilation engineers on ships use mostly direct drives because of the compactness and space saving—and space saving is an important factor in designing any part of a ship. The fans operate at motor speed or higher and are direct connected to the ducts, supplying air streams of two, three, four, five and even six inches. Two speed motors are usually provided, especially where the air is preheated before being distributed. Occasionally multi-speed motors are installed, variable on a.c. and d.c.

It is necessary to rat-proof all fan intakes with coverings of at least half-inch mesh. For the tropics the fan intakes are also provided with mosquito-proof coverings. The small ducts also help in getting around beams, electric and steam lines. More and more ship designers are beginning to consider the size of ducts, rational sizing for different parts of the vessel, static regain, shock losses and friction losses, as well as change of direction of air flow, which may cause a pressure loss, all in consultation with the ventilating engineers.

ASRE Annual Meeting Program

ST. LOUIS—Refrigeration in the defense program was the central theme of the 37th annual meeting of The American Society of Refrigerating Engineers, which opened Dec. 2 in the Hotel Jefferson here. Government contracts, priorities, substitute materials and other vital, timely problems in the refrigeration and air conditioning industries were considered in detail by the speakers and also in informal discussion sessions.

The program includes:

DECEMBER 3

A.M.

"Metals for Sub-Zero Temperatures"—L. H. Carr, The Edward Valve and Manufacturing Co., East Chicago, Ind.

Forum on Substitute Metals—Discussion by A. B. Schellenberg, K. M. Newcum, M. F. Tokach.

"Procedure in Government Business by the Refrigeration Industry"—C. W. Shearman, OPM, Washington, D. C.

"Recent Developments in Large Ammonia Absorption Systems"—R. L. Jones and J. R. Chamberlain, York Ice Machinery Corp., York, Pa.

DECEMBER 4

A.M.

"Allies of Refrigeration in Meat Preservation"—Prof. Arthur W. Ewell, Westinghouse Electric and Mfg. Co., East Springfield, Mass.

"Plastics as Substitute Materials"—G. C. Gress, Regional Sales Manager, Plastics Division, Monsanto Chemical Co., Springfield, Mass.

"Heat Transfer of Evaporating Freon in Tubes"—Carlyle M. Ashley, Research Division, Carrier Corporation, Syracuse, N. Y.

"Standard Methods of Rating and Testing Evaporative Condensers."

DECEMBER 5

A.M.

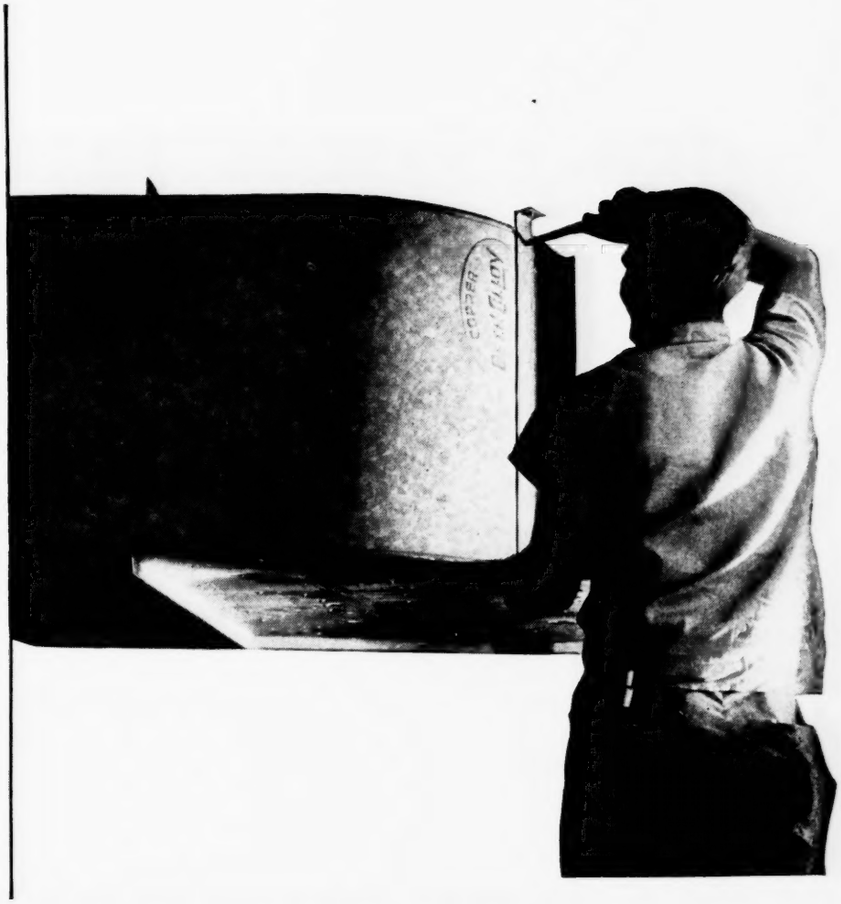
Final inspection trips of St. Louis manufacturing plants, by arrangement. Alco Valve Company; Century Electric Company; Curtis Refrigerating Machine Company; Cyclotron; Hussmann-Ligonier Company; Marlo Coil Company; Nelson Company; Pevely Dairy; Spoehrer-Lange Company; St. Louis Dairy; Wagner Electric Corporation; White-Rodgers Company.

An attractive entertainment program was arranged by the local committee of St. Louis hosts, under A. T. Marlo, general chairman and chairman of the St. Louis Section.

SCHOOL ON WHEELS FOR DELCO-HEAT SERVICEMEN

(Left) Up-to-date methods of servicing automatic heat are taught Delco-Heat servicemen by the crew of engineers who man this Service-Trainer, a traveling automatic heat laboratory. (Right) Interior view of the truck showing some of its equipment that includes both a conversion burner and a Delco Conditionair actually under fire and operating automatically. An automatic water heater, a stoker, a stock of parts, and panels of controls for oil, gas, and coal units are among the Trainer's other equipment. The course for servicemen is presented by Curt Eggleston, Delco-Heat Service Engineer, who has charge of the Trainer and who is assisted by Les DeCracker.

Air ducts last longer



WHEN YOU BUILD 'EM WITH

BETH-CU-LOY GALVANIZED STEEL SHEETS

You can materially increase duct life—and help to save valuable steel for future defense needs—by using Beth-Cu-Loy Galvanized Steel Sheets for all duct work. Beth-Cu-Loy sheets are protected against corrosion two ways: by a tight coating of zinc, and by the addition of 0.20 to 0.30 per cent copper to the steel itself. Tests made by the American Society for Testing Materials have consistently proved that sheets of Beth-Cu-Loy analysis outlast ordinary steel sheets from two to three times. That means longer duct life under any conditions, yet the added cost of Beth-Cu-Loy is only a few cents more per sheet.

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY

Short Cut Heat Loss Calculation Method Devised by University of Illinois Staff

URBANA, ILL.—The research staff of the University of Illinois has prepared a short-cut method of calculating heat losses which involves the use of heat loss factors and which will be known as the National Warm Air Association Tables of Heat Loss Factors and which are copyrighted by the Association. The method is said to be strictly precise.

Heat loss factors are presented for 105 different types of common construction of walls, frame partitions, ceilings, roofs, floors, windows, and doors. These factors are given for design temperature differences between indoors and outdoors ranging all the way from 40F to 100F. A sample portion of these tables is shown in the accompanying tabulation.

The following advantages may be apparent:

(a) Multiplying the heat loss factor by the square feet of exposed surfaces gives the Btu heat loss per hour from that surface;

(b) In any given locality the designer can select the column of figures appropriate for that locality;

(c) There is no necessity of estimating the probable attic temperatures, temperatures of unheated closet spaces, temperatures below the floor, ground temperatures, etc., since these have all been taken into account;

(d) Use of round numbers and the elimination of decimals, will make calculations easier and less subject to errors; and

(e) No corrections are necessary for temperature differences other than 70F, if the proper column is selected.

The National Warm Air Association method will appear in printed form in a publication entitled Standard Code Application Manual to be issued shortly.

These tables and answers to any questions pertaining to them will be presented by Professor S. Konzo at the coming January meeting of the Association at Philadelphia.

Warm Air Group to Meet in Philadelphia

COLUMBUS—The twenty-eighth annual convention of the National Warm Air Heating and Air Conditioning Association to be held in Philadelphia, January 26-28, will be opened with an address by President C. A. Olsen, according to an announcement from the Association.

The morning session on the opening day will be devoted to furnace and allied manufacturers for the purpose of considering problems of the industry.

Among the Government representatives invited are Leighton H. Peebles, of OPM, Sullivan Jones, and a representative of SPAB. W. L. McGrath, member of the Plumbing and Heating Industry Advisory Committee, has also been asked to speak.

The second day of the convention will be devoted to technical subjects covered by Professors A. P. Kratz and S. Konzo of the University of Illinois, F. G. Sedgwick, chairman of the research advisory committee, and W. D. Redrup, chairman of the codes committee, and to a joint meeting with the ASHVE.

Vernon Talks to Washington Group

WASHINGTON — The regular meeting of the Washington chapter, ASHVE, was held at the Dodge Hotel with 45 members and guests in attendance. Following the regular meeting, J. R. Vernon, Johnson Service Company, spoke on temperature control for defense industries.

Boston NDHA Elects Ulbrich

BOSTON—Officers for the ensuing year were elected at the fall dinner meeting, Nov. 6, of the Boston section, National District Heating Association, as follows: Chairman, M. Ulbrich, Cambridge Electric Light Company; vice chairman, E. A. Edwards, American District steam Co.; treasurer, Morrill Dakin, Concord Electric Light & Power Company; secretary, F. C. Meyer, Boston Edison Company; executive committee, D. F. Kavanagh, Taunton Municipal Electric department; P. T. Reuter, Bailey Meter Company and A. L. Dutton, Boston Edison Company.

M. Ulbrich

A special committee to conduct a drive for new members was also appointed: G. H. Goudy, Cambridge Electric, chairman; David Little, Boston Edison; G. K. Saurwein, Harvard University steam service department; C. F. Buckley, Taunton Municipal Electric department, and P. J. Reuter.

Abstracts and discussion of selected papers presented at the national convention of the Association was conducted as follows: Operating Statistics, C. F. Buckley; Steam Station Engineering, David Little; Commercial Relations, F. C. Meyer, and Research, G. K. Saurwein. Open discussion followed presentation of the abstracts, and this, with the discussion by those in charge of the papers, made this one of the most interesting meetings that the Section has had for some time.

Ordnance Plant Described

PITTSBURGH—The Pittsburgh chapter of the ASHVE held its monthly meeting November 10, with R. M. Rush, manager of the Industrial Department, Dravo Corporation, as speaker of the evening. The subject of the talk was on the Design and Installation of the Heating System for the U. S. Naval Ordnance Plant, South Charleston, W. Va.

The questions concerning the talk were answered by H. A. Pietsch, Dravo chief engineer.

P.R.R. Will Have 2162 A.C. Cars

PHILADELPHIA—In order to place 100 additional air-conditioned and modernized coaches in service for the summer of 1942, the Pennsylvania Railroad announced Nov. 24 that it will undertake a $3,500,000 passenger coach renovation plan this winter.

HEAT LOSS FACTORS

Description	Heat Transmission Coefficient, U	Heat Loss Factor (Multiply Values Shown by Exposed Areas in Sq Ft) — Design Temperature Difference, F									
		40	50	60	65	70	75	80	85	90	100
Exposed Walls, No. 1											
(a) Frame, wood siding, paper, sheathing, studs, lath and plaster	0.25	10	13	15	16	18	19	20	21	23	25
(b) Same as (1a) substituting ½ in. rigid insulation for lath	0.19	8	10	11	12	13	14	15	16	17	19
Frame Interior Partitions No. 14											
(a) With lath and plaster on side; other side open	0.62	12	16	19	20	22	23	25	26	28	31
Ceilings with Attic Space Above, No. 16	Combined Coefficient										
(a) Lath and plaster, no floor above	0.32	13	16	19	21	22	24	26	27	29	32

PRODUCTION STEPPED-UP... FUEL SAVED

Comfortable working temperatures are maintained for the workers on this Marmón Herrington military tractor assembly line by Young FH 4-blower fan unit heaters, ceiling mounted, each with a capacity of 800,000 Btu. per hour.

YOUNG HEATING UNITS SELECTED FOR NEW MARMON-HERRINGTON PLANT!

To date, 5 carloads of YOUNG unit heaters and convectors have been installed in Marmon-Herrington's rapidly growing plant at Indianapolis. This company, an important builder of army mobile units, is one of many manufacturers now specifying YOUNG heating units for new plants and to modernize existing facilities.

YOUNG units provide maximum heat output at minimum fuel cost. They have a quick pick-up and circulate an ample supply of warm air to promote health and efficiency among workers. They have patented features of construction that assure easy installation and long, trouble-free operation. Ask the YOUNG representative in your city for engineering data, or write to—

YOUNG RADIATOR CO.,
Dept. 101M, Racine, Wis.

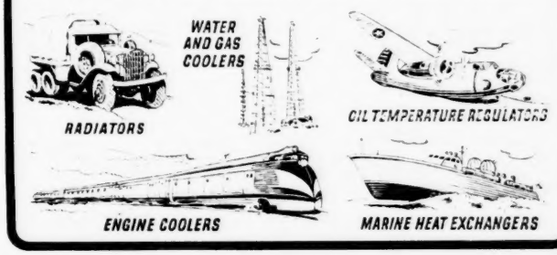
★

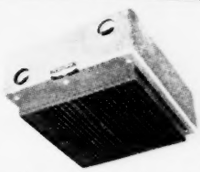
SEE OUR EXHIBIT AT THE 7th ANNUAL HEATING and VENTILATING EXPOSITION

Commercial Museum, Philadelphia, Pa. January 26-30, 1942

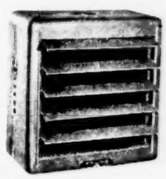
YOUNG PRODUCTS IN NATIONAL DEFENSE

In addition to heating and air conditioning units for defense plants, military cantonments, etc. the Young Radiator Company manufactures more than 100 heat transfer products for the Army, Navy and industries vital to National Defense.

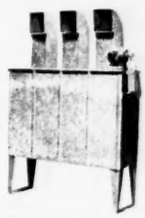




YOUNG *VERTIFLOW* UNIT HEATER



YOUNG TYPE "SH" UNIT HEATER



YOUNG TYPE "FH" UNIT HEATER

YOUNG "STREAMAIRE" CONVECTOR

THE YOUNG LINE Includes—

"Streamaire" Air Conditioning Units, Ductless Units, Water Coils, Evaporator Coils, Commercial Heat Transfer Units, Blast Units.

Young

HEATING, COOLING AND AIR-CONDITIONING UNITS

Frank C. Reeder

KNOXVILL, TENN.—Frank C. Reeder, for the past 34 years field service engineer for the Fulton Sylphon Co., died November 12. He was recognized as an outstanding practical authority on temperature control.

Frank C. Reeder

Mr. Reeder was born on January 9, 1867, at Jamestown, Ohio. He was first initiated into the plumbing and heating business by serving as salesman for Tennessee Mill & Mine Supply Co. Later, he served in the same capacity with the American Radiator Co. During his long service with Fulton Sylphon Mr. Reeder traveled over 35,000 miles per year and won a host of friends who called him Uncle.

He is survived by his wife and two children.

A. Haydn Myer

BIRMINGHAM, ALA.—A. Haydn Myer, 75, died here at the home of his son, Haydn Myer, November 19. Prior to 1907 Mr. Myer was a heating contractor in Lincoln, Neb., and in 1907 joined the old American Radiator Company in Omaha and was later transferred to this company's general offices then in Chicago. He was well known throughout the country due to his extensive traveling as a special representative. He retired in 1928 and moved to Birmingham where he lived with his son, well known in Birmingham as a manufacturer's representative. Mr. Myer will be remembered particularly by some because of his Btu slide rule for estimating radiation requirements, widely distributed before and after the first World War.

Henry B. Armitage

PORT CHESTER, N. Y.—Henry B. Armitage, 59, vice president of Baker Smith & Co., Inc., New York, died Nov. 12 at the United Hospital here. His residence was in Larchmont.

He began work with the Baker Smith Company in 1903 and remained in active service with them until last June.

LETTERS TO THE EDITOR

Lower Inside Temperatures

EDITOR, HEATING AND VENTILATING:

Your article in the November HEATING AND VENTILATING on the fuel saving due to lower inside temperatures was very interesting. However, the next to the last paragraph states that it is doubtful if anyone really knows whether the theoretical saving would actually take place. You also go on and state that until data proving otherwise are available it would seem logical to base calculations on this method.

During the last several years, I have had several experiences with various temperatures in different types of buildings. Some of the buildings were markets, some were small shops, others offices and homes and in each case in estimating the fuel cost we have always taken into consideration the average weekly temperature and based our estimate on this average. Experience has borne out the validity of this procedure and it has been very interesting to note how accurately fuel consumption follows any raising or lowering of the temperature. In view of the general experience obtained I would unhesitatingly state that your formulae are basically correct and could be followed in almost any case to determine the expected saving due to lower average temperature.

Stores or offices which are opened from 8 to 6 every day with the exception of Sunday will use a much lower corresponding fuel than a home which is opened or rather up to day-time temperature from 7 in the morning until 10 or 11 at night, seven days a week, or for instance, a drug store which maintains about the same hours of operation as the average home.

In another paragraph you state that there is no rule to indicate that a thermostat can't be set back to fifty-five or below. It has been our experience that the amount of radiation in the building determines the night setting of the thermostat. A building amply or over radiated can be set back to a lower temperature and reheated easily in the morning. However, a building that has a scarcity of radiation should not be set back more than five degrees, if that, during the night time if it is desired to reheat at all quickly in the morning.

In connection with this thought it might be well to state in some cases lower operating costs have been obtained with badly under radiated systems by maintaining a constant temperature twenty-four hours a day. This was due to the fact that if a lower night temperature was maintained the radiation was so much under sized that it was almost impossible to reheat to a satisfactory day temperature in the morning in short of four or five and in some cases six hours.

B. T. POOR

Chief Heating Engineer,
Blackstone Valley Gas & Elect. Co.,
Pawtucket, R. I.

(What the writer of the article meant to imply in his next-to-last paragraph was that no one knows *exactly* what the theoretical savings are. There is little question that there are substantial savings made—*Editor.)*

Mercoids, Too

In one of the two articles in last month's issue on Wright Aeronautical Corporation's plant in Lockland, Ohio, the author inadvertantly omitted including among equipment suppliers the Mercoid Corporation which furnished the unit heater controls—*Editor.*

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACTS OF CONGRESS OF AUGUST 24, 1912, OF HEATING AND VENTILATING, published monthly at New York, N. Y., for October 1, 1941.

State of New York, County of New York, ss.:

Before me, a Notary Public in and for the State and County aforesaid, personally appeared Edgar A. Becker, who, having been duly sworn according to law, deposes and says that he is the Treasurer of The Industrial Press, publishers of HEATING AND VENTILATING and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, The Industrial Press, 140-148 Lafayette St., New York, N. Y.

Editor, Clifford Strock, 140-148 Lafayette St., New York, N. Y.

Managing Editor, none.

Business Managers, Robert B. Luchars, 140-148 Lafayette St., New York, N. Y.; Edgar A. Becker, 140-148 Lafayette St., New York, N. Y.; Erik Oberg, 140-148 Lafayette St., New York, N. Y.

2. That the owner is:

The Industrial Press, 140-148 Lafayette St., New York, N. Y.; Erik Oberg, 140-148 Lafayette St., New York, N. Y.; Robert B. Luchars, 140-148 Lafayette St., New York, N. Y.; Edgar A. Becker, 140-148 Lafayette St., New York, N. Y.; Laura A. Brownell, 140-148 Lafayette St., New York, N. Y.; Franklin D. Jones, 140-148 Lafayette St., New York, N. Y.; First National Bank and Trust Co. of Montclair and Robert B. Luchars, Trustees (Beneficiaries unknown), Upper Montclair, N. J.; First National Bank and Trust Co. of Montclair and Leigh Roy Urban, Trustees (Beneficiaries unknown), Upper Montclair, N. J.; First National Bank and Trust Co. of Montclair and Kenneth D. Ketchum, Trustees (Beneficiaries unknown), Upper Montclair, N. J.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are:

Laura A. Brownell, 140-148 Lafayette St., New York, N. Y.; John Connolly, 140-148 Lafayette St., New York, N. Y.; Franklin D. Jones, 140-148 Lafayette St., New York, N. Y.; Robert B. Luchars, 140-148 Lafayette St., New York, N. Y.; Louis Pelletier, 140-148 Lafayette St., New York, N. Y.; Elizabeth Y. Urban, 163 Western Drive, Longmeadow, Mass.; Helen L. Ketchum, King St., Cohasset, Mass.; Wilbert A Mitchell, 28 Harlow Road, Springfield, Vt.; Henry V. Oberg, 1317 Hill Crest Road, R.D. No. 1, Lancaster, Pa.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholders or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

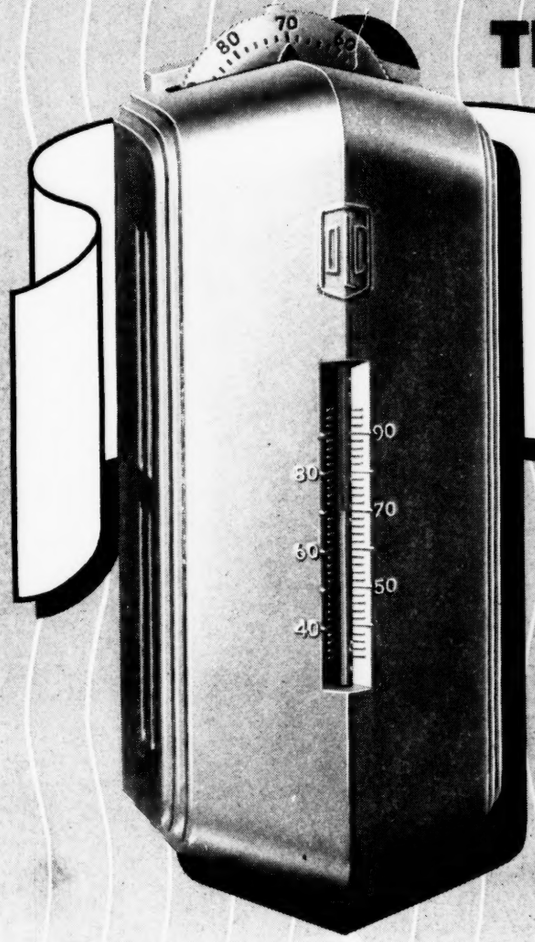
EDGAR A. BECKER, Treasurer.

Sworn to and subscribed before me this 25th day of September, 1941.

CHARLES P. ABEL.

Notary Public, Kings County No. 313; Kings Register's No. 3109; N. Y. County No. 231; N. Y. Register's No. 3-A-161. My commission expires March 30, 1943.

FUEL SAVING IS MORE IMPORTANT THAN EVER BEFORE



THE 411 COMPENSATED THERMOSTAT SAVES FUEL

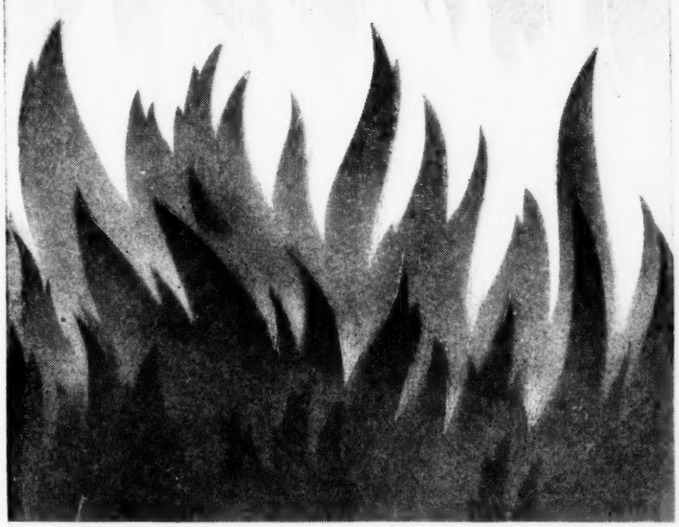
Every kind of fuel for heating—oil, gas or coal—may cost more this winter and may be harder to get. National defense needs make this inevitable.

The 411 Compensated Thermostat stops fuel waste by holding temperatures to closest possible limits. This results not only in important savings but conservation of fuel as well.

The 411 is a superior comfort guarantee, also. It controls automatic heating systems to eliminate uncomfortable "Cold 70", as well as objectionable overheating.

The compensating preheater element provides sensitivity, most important in automatic heating. This element in the 411 need not be replaced to meet variations in local heating requirements. A simple screw driver adjustment (patented) takes care of any situation.

The 411 is available also in day and night type—the turn down is accomplished by a second preheater which greatly simplifies construction—holds cost to a minimum.



Detroit Lubricator Company make a complete line of heating controls. You can match the 411 with controls throughout the system which work in perfect harmony. The use of all-Detroit controls avoids divided responsibility.

DETROIT LUBRICATOR COMPANY

General Offices: DETROIT, MICHIGAN

Canadian Representatives—RAILWAY AND ENGINEERING SPECIALTIES LIMITED, Montreal, Toronto, Winnipeg

NEW EQUIPMENT

Self contained soldering unit for soldering electrical wires

Jiggers Electrical Wire Soldering Unit

NAME—Jiggers.

PURPOSE—A small self-contained soldering unit which can be ignited for forming a soldered electrical connection.

FEATURES—Each Jigger is a small self-contained soldering unit that is said to contain just the correct proportion of 50-50 solder and flux hermetically sealed within a waterproof heat generating outer shell. The manufacturer states that to obtain a strong perfectly soldered electrical connection it is only necessary to push the wire splice into a Jigger and touch a lighted match to the Jigger. The Jigger shell ignites and is said to produce the proper temperature to flow the solder into the splice. The burnt shell is then dropped off leaving a smooth soldered splice. To demonstrate that these devices work the manufacturer is offering free samples. Write to address below mentioning Heating and Ventilating.

MADE BY—*Jiggers Inc., 215 West Illinois Street, Chicago, Ill.*

Perfex Fan Control

NAME — Perfex Two-Speed Fan Control.

PURPOSE—For controlling operation of fans on forced warm air systems employing two-speed fans.

FEATURES—This control can be set to switch the fan from low to high speeds at any desired bonnet temperature. All cut-in and cut-out settings are made independently. The bonnet temperature is indicated on an external scale. Turning the external knob to the summer cooling position produces continuous high speed fan operation without disturbing temperature settings.

MADE BY — *Perfex Corporation, 500 West Oklahoma Ave., Milwaukee, Wis.*

Perfex two-speed fan control

Baldwin-Hill Insulating Board

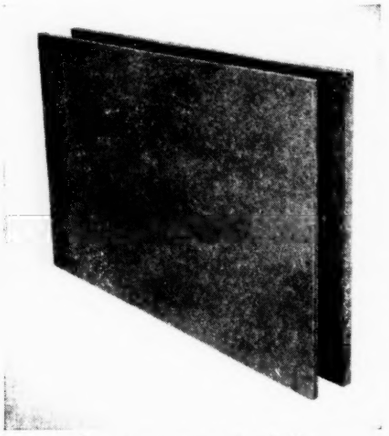
NAME—BH Koldboard.

PURPOSE — For low temperature insulation.

FEATURES—This board insulation is fabricated of chemically stable rockwool fibres, felted and bonded together to form a semi-rigid block. The manufacturer states that the board shows a moisture absorption of 0.68% at a relative humidity of 65% and a temperature of 75F. The thermo-conductivity is said to be 0.32 Btu's per sq ft per hr per deg F. at a mean temperature of 75F. Density is 17 lb per cu ft and the modulous rupture is 50 lb per sq in.

SIZES — Made in blocks 36 in. long 12, 18 and 24 in. wide. One-half to 2 in. thick.

MADE BY—*Baldwin-Hill Co., Trenton, N. J.*



Low temperature insulation

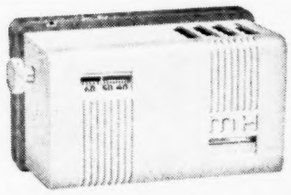
Spee-D Chemical Systems

NAME—Spee-D chemical duct cleaning systems.

PURPOSE—A service for cleaning and dust proofing air conditioning equipment.

FEATURES—It is said that a single treatment by factory trained service men of this air conditioning equipment cleaning service eliminates and prevents accumulation of dust. Manufacturer states that this chemical process thoroughly cleans ducts, fans, heating coils, filters, humidity controls and heat transfer equipment. It is further stated that the process is guaranteed to keep the equipment clean for a period of one year and that the process is odorless and harmless to person, property and foodstuffs.

MADE BY —*Spee-D Chemical Systems, Cleaning Service Division, 622 Broadway, Cincinnati, Ohio.*



M-H horizontal line voltage thermostats

Minneapolis-Honeywell Thermostats

NAME — M-H thermostats TA42A and TA42B.

PURPOSE — Two thermostats of horizontal design, one for heating applications and the other for heating and cooling.

FEATURES — Thermostats have been designed for handling directly large motor driven units, cold blowers, cooling equipment, industrial and commercial stokers and similar equipment. On larger or polyphase motors they should be used in connection with magnetic starters. The horizontal design is said to provide a maximum circulation and greatly reduce the effect of contact heat. Thermostats are equipped with a temperature setting knob which can be removed to lock the thermostat in order to prevent tampering. Thermostat TA42A makes contact on temperature fall while thermostat TA42B makes contact on temperature rise and can be used with series 60 control through use of extra contact.

MADE BY — *Minneapolis - Honeywell Regulator Company, Minneapolis, Minn.*

Chelsea Fan Blade

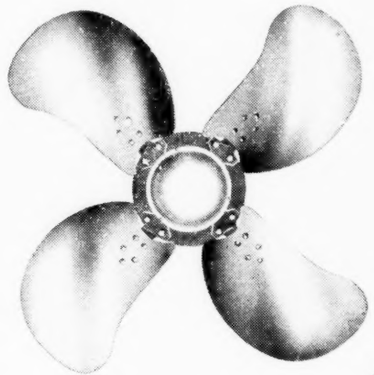
NAME—Chelsea fan blade.

PURPOSE—A fan blade designed to move air at low noise levels.

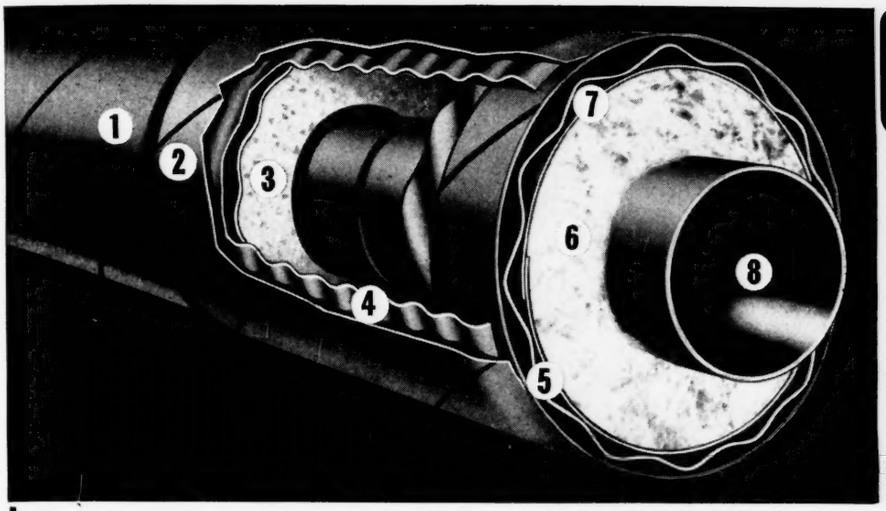
FEATURES—Fan blade is said to be precision balanced to insure perfect alignment and is made of polished steel with die stamped and die formed blades.

SIZES—19 in. to 72 in.

MADE BY — *Chelsea Fan & Blower Co., 1550 Grove St., Irvington, N. J.*



Chelsea fan blade



RIC-WIL

1. ASBESTOS FELT OVER ASPHALT COATED HEL-COR INGOT IRON
2. THICK STRIP ASPHALT APPLIED AFTER WELDING
3. PIPE SUPPORT AND ALIGNMENT GUIDE
4. COUPLER
5. AIR SPACE
6. RIC-WIL DRY-PAC INSULATION
7. ASBESTOS FELT JACKET
8. STEAM PIPE

PRE-SEALED INSULATED PIPE UNITS

● The factory pre-fabricated system, completely engineered for modern demands on underground distribution of steam, hot water, and oil • High thermal efficiency, long life, low installation cost • Each unit shipped complete as shown, in 20-ft. units, or as required • All fittings and accessories included • Units are joined by split coupling or by welding • Insulation can be any type specified by you • Prompt shipment—speedy installation—nothing else to buy • Bulletin on request.

THE RIC-WIL COMPANY CLEVELAND, OHIO
Agents in Principal Cities

DE-STA-CO Blower Wheel Housings

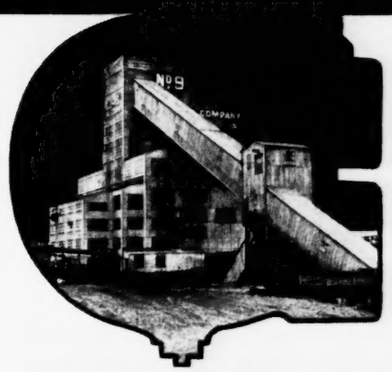
of Standard Dimensions

Made in sizes to fit 4½, 5, 6, 7½ and 9 inch wheels and in widths to suit single or double inlet wheels . . . also individual parts for your own assembly.

De-Sta-Co housings are engineered for maximum efficiency and quietness in operation . . . neatly finished. Send for "De-Sta-Co Blower Housings" bulletin; gives complete information, including essential dimensions.

DETROIT STAMPING CO.
Established Over 25 Years
375 Midland Ave • Detroit, Mich.

HEATING "ALL OUT-DOORS"



WITH SARCO STEAM TRAPS

The engineers ot this huge multi-story coal plant faced a heating problem almost as big as "all outdoors." The big coal breaker is heated by unit heaters of 650,000 b.t.u. capacity, drained by Sarco Float-Thermostatic Steam Traps. Dozens of Sarcos keep this plant warm—including track heating lines in the yard.

Sarco Steam Traps were selected because of their satisfactory performance for many years on similar installations in the coal region.

Indoors or out, there is a Sarco Steam Trap for every purpose. Ask for the Sarco catalogs.

116

SARCO SAVES STEAM

SARCO COMPANY, INC.
475 Fifth Avenue, New York, N. Y.
SARCO CANADA LTD., FEDERAL BLDG., TORONTO, ONT.

Number of Degree-Days for October, 1941

HEATING and VENTILATING continues its fourteenth year of publishing degree-day data for various large cities. Forty-four cities have been added to those previously published, making a total of 114 cities listed below.

City	Degree-Days Oct. 1940	Degree-Days Oct. 1941	Degree-Days Season 1941-42
Albany, N. Y.	593	435	563
Alpena, Mich.	529	486	668
Atlanta, Ga.	62	44	44
Atlantic City, N. J.	350	170	193
Baker, Ore.	461	589	977
Baltimore, Md.	296	134	142
Binghamton, N. Y.	558	365	478
Birmingham, Ala.	43	24	24
Bismarck, N. D.	435	601	881
Boise, Idaho	327	434	657
Boston, Mass.	450	299	388
Buffalo, N. Y.	502	382	455
Burlington, Vt.	635	560	762
Cairo, Ill.	85	97	104
Canton, N. Y.	670	549	745
Charles City, Iowa	318	396	513
Charlotte, N. C.	119	51	51
Chattanooga, Tenn.	146	69	69
Cheyenne, Wyo.	457	625	937
Chicago, Ill.	245	266	317
Cincinnati, Ohio	193	170	194
Cleveland, Ohio	348	307	360
Columbia, Mo.	118	179	226
Columbus, Ohio	265	214	240
Concord, N. H.	571	534	735
Concordia, Kan.	103	288	347
Davenport, Iowa	182	259	319
Dayton, Ohio	249	214	248
Denver, Colo.	284	461	627
Des Moines, Iowa	175	287	365
Detroit, Mich.	407	328	389
Dodge City, Kan.	104	267	327
Dubuque, Iowa	271	311	385
Duluth, Minn.	504	588	849
Eastport, Me.	647	574	826
Elkins, W. Va.	399	267	355
El Paso, Tex.	58	72	72
Erie, Pa.	422	297	356
Escanaba, Mich.	510	517	710
Evansville, Ind.	171	154	173
Fort Smith, Ark.	37	85	88
Fort Wayne, Ind.	300	319	377
Fort Worth, Tex.	19	80	80
Grand Rapids, Mich.	382	338	408
Green Bay, Wis.	417	410	526
Greensboro, N. C.	219	115	119
Harrisburg, Pa.	418	236	266
Hartford, Conn.	525	343	447
Helena, Mont.	478	697	1133
Huron, S. D.	291	462	619
Indianapolis, Ind.	178	187	214
Ithaca, N. Y.	552	395	509
Kansas City, Mo.	86	182	225
Keokuk, Iowa	141	211	263
Knoxville, Tenn.	137	82	82
La Crosse, Wis.	346	389	500
Lander, Wyo.	467	705	1076
Lansing, Mich.	458	387	491
Lincoln, Neb.	111	300	371
Little Rock, Ark.	34	74	77
Los Angeles, Calif.	32	71	75
Louisville, Ky.	132	129	136
Lynchburg, Va.	236	126	136
Madison, Wis.	329	351	442
Marquette, Mich.	506	543	739
Memphis, Tenn.	45	77	79
Milwaukee, Wis.	307	388	493
Minneapolis, Minn.	347	440	577
Nantucket, Mass.	434	298	387
Nashville, Tenn.	90	75	76
New Haven, Conn.	443	272	344
New Orleans, La.	3	5	5
New York, N. Y.	371	208	234
Norfolk, Va.	182	58	58
Northfield, Vt.	694	602	874
North Platte, Neb.	244	403	535
Oklahoma City, Okla.	44	141	155
Omaha, Neb.	145	313	390
Oswego, N. Y.	514	404	525
Parkersburg, W. Va.	280	191	221
Peoria, Ill.	204	243	304
Philadelphia, Pa.	335	162	174
Pittsburgh, Pa.	331	226	258
Pocatello, Idaho	428	569	876
Portland, Me.	528	520	736
Portland, Ore.	209	271	384
Providence, R. I.	454	295	371
Pueblo, Colo.	269	410	544
Raleigh, N. C.	166	56	57
Reading, Pa.	421	221	256
Reno, Nev.	317	475	691
Richmond, Va.	237	100	107
Rochester, N. Y.	551	409	522
Roseburg, Ore.	205	319	462
St. Joseph, Mo.	89	230	292
St. Louis, Mo.	82	141	174
Salt Lake City, Utah	242	423	590
Sandusky, Ohio	330	267	303
San Francisco, Calif.	116	150	229
Sault Ste. Marie, Mich.	606	627	891
Scranton, Pa.	526	316	406
Seattle, Wash.	246	322	507
Spokane, Wash.	376	543	827
Springfield, Ill.	128	185	231
Springfield, Mo.	115	173	220
Syracuse, N. Y.	555	395	534
Tacoma, Wash.	288	364	576
Terre Haute, Ind.	156	178	209
Toledo, Ohio	343	288	336
Trenton, N. J.	408	215	249
Utica, N. Y.	574	467	615
Washington, D. C.	300	144	153
Wichita, Kan.	77	213	259
Yakima, Wash.	307	428	604

Accuracy to Millionths of an Inch with

TRADE FRICK MARK

The parts for tanks, planes and guns, produced in thousands of separate plants, can only fit together properly if made in standard sizes, to accurate gages. Pratt and Whitney secure accuracy to millionths of an inch by finishing their Hoke precision gage blocks in this air conditioned room at West Hartford, Connecticut.

Standard conditions of 68° F. and 50% relative humidity are maintained, 24 hours a day the year round, with Frick Equipment. This working space, covering 16,800 sq. ft., is believed to be more accurately controlled than any other of like size in existence. Full credit is due the Automatic Refrigerating Co., Frick Distributors at Hartford.

Put your air conditioning problems up to the experts who have nearly 60 years' experience back of their recommendations. Write **FRICK CO., Waynesboro, Penna.**

Air Conditioning

The All Purpose

AIR VELOCITY METER

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INSTANTANEOUS DIRECT READING

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Illinois Testing Laboratories Inc.

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THERM-O-TILE

Reg. U. S. Pat. Off.

Underground Steam Conduit

Therm-O-Tile Is the Simplest, Strongest, Most Efficient, and Only Truly Complete Conduit for Underground Pipe Lines

Unyielding monolithic concrete base. No broken stone fill. No bell joints. Build to correct grade with Therm-O-Tile and that grade will never change. Condensate pockets cannot form. Strong arched construction. Internal channel drain. Etc. For the numerous other reasons why Therm-O-Tile is by far the superior conduit system, ask for Bulletin 381.

Sold and installed by Johns-Manville Construction Units in all Principal Cities.

See our page in Sweet's or The Heating Guide.

H. W. PORTER & CO., Inc.
823-V Frelinghuysen Ave.
Newark, New Jersey

H. W. Porter & Co., Inc., 823-V Frelinghuysen Ave., Newark, N. J.
Without obligating us in any way, ☐ Please send Bulletin 381.
☐ Send representative. ☐ Enclosed is a sketch, with principal data of a prospective job, on which we shall be glad to have your ☐ comments. ☐ quotations.

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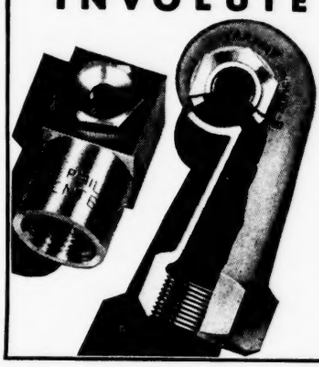
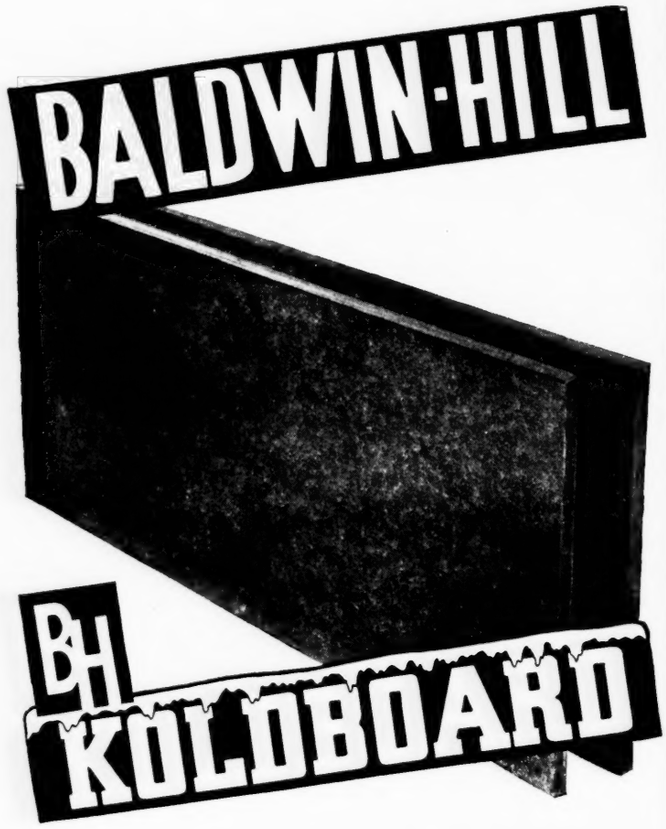
YARWAY INVOLUTE NOZZLES



The preference for trouble-free air washing service — because there are no internal parts or vanes to wear or clog. Proven through many years of service in water cooling and air conditioning installations totaling more than 5 million g. p. m.

Made in sizes and types for all requirements. Ask for Bulletin N-615.

YARNALL-WARING CO., PHILA.
104 MERMAID AVENUE



LOW TEMPERATURE INSULATION

B-H KOLDBOARD—with mineral base—answers the urgent demand for an economical, highly efficient refrigeration insulation. Highly resistant to moisture (0.68% moisture absorption at a relative humidity of 65% at a temperature of 75° F.) it eliminates the major cause of low temperature insulation failure, the infiltration of moisture. And it has a low thermal conductivity of only 0.32 B.t.u.'s. Write us for more complete information, heat loss chart, conductivity curve or call in a B-H engineer to advise on any specific application or insulation problem.

BALDWIN-HILL CO.
529 KLAGG AVE., TRENTON, N. J.
NEW YORK—CHICAGO—KALAMAZOO, MICH.

We also make a complete line of Heat Insulation Products
B-H MONO-BLOCK . . . B-H No. 1 INSULATING CEMENT
B-H ROCKWOOL BLANKET...B-H No. 100 PIPE COVERING
B-H FELT INSULATION...B-H WEATHERSEAL AND OTHERS

WITH THE MANUFACTURERS

The Ashcroft Gauge Division of Manning, Maxwell & Moore, Inc., Bridgeport, Conn., is celebrating its 90th birthday this year. The Bourdon tube principle of making pressure gauges was invented by a French professor of that name. Ashcroft, the founder of the present Ashcroft Company, saw his gauge on exhibition at the first International Industrial Exposition in London in 1851, and obtained the exclusive rights to manufacture it in the U. S.

Carrier Corp., Syracuse, N. Y., held the second annual dinner of its 10-Year Plus Service Club, November 1, at the Hotel Onondaga, Syracuse. Engineers, factory and construction men, salesmen and office personnel—some with more than 30 years of employment and many of them travelling from long distances—attended. Principal company speaker was *J. I. Lyle*, President and a co-founder of Carrier Corporation. Mr. Lyle's theme was the objectives and obligations of a corporation, its stockholders and personnel. *Donald E. French*, vice-president and director of the Carrier Development Laboratory was toastmaster. *Dr. Willis H. Carrier*, chairman of Carrier's board, presented service pins to 62 members of the 10-year club.

Johns-Manville, New York, N. Y., is constructing an asbestos mill capable of processing large quantities of asbestos-bearing rock in Chrysotile, Ariz. The new mill will be in operation early in 1942, and will at that time add substantially to the supply of asbestos fibre available in this country to meet defense manufacturing needs. The asbestos fibre found at Chrysotile is particularly valuable in the manufacture of filters, woven asbestos materials, asbestos paper, many types of asbestos-cement products, and as fillers in asphalt tile and moulding compounds.

Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., for the fourth time in five years is building an addition to its Minneapolis plant, according to C. B. Sweatt, vice-president in charge of sales. Rising four stories above the north wing just completed last year, the 65,000 square feet of added floor space is necessary because of recent defense orders and to maintain the best possible service to its customers.

Construction begins on M-H plant addition.

PERSONALS & PERSONNEL

General Electric Co., Air Conditioning and Refrigeration Dept., Bloomfield, N. J., has appointed *F. T. Grothouse* as engineer in charge at the department's Winter Street plant in Fort Wayne, Ind., and *D. W. McLenegan* as engineer in charge at the Bloomfield Works. Mr. Grothouse joined GE in 1921 at Fort Wayne and was engaged in special machine and factory equipment design there until 1928 when he was transferred to the electric refrigeration engineering department of Fort Wayne's Winter Street plant. In 1936 he was placed in charge of the refrigerant condensing unit design section of the refrigeration engineering department in Fort Wayne. In March, 1940, he became engineer of the production engineering section of the Winter Street plant. Mr. McLenegan joined the company in Schenectady in June, 1922. For two years he was assigned to the research laboratory on mechanical problems. From 1923 to 1931 he worked in the industrial engineering department on motor and control application and standardization, and in 1931-32 assisted in the advance work leading to the formation of the air conditioning department. He joined this department in 1932, serving consecutively in the commercial, commercial engineering, and engineering design sections.

F. T. Grothouse

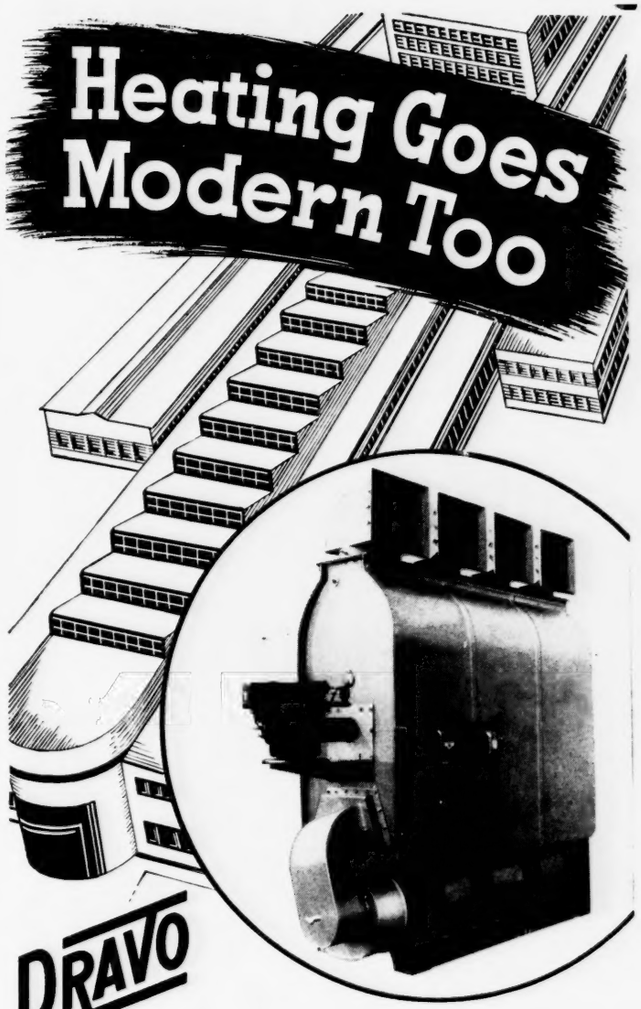
D. W. McLenegan

Carl A. Goth, Iowa City, Iowa, has been appointed heating engineer for the Government, with headquarters at Omaha. He will design and supervise installation of heating systems for government building projects now under construction. Since 1938, Mr. Goth has been heating sales engineer for the Iowa City Light and Power Company, at Iowa City.

Yarnall-Waring Company, Philadelphia, announces the following personnel changes in its sales organization: *C. Wilson, Jr.*, formerly of the New York office, has been appointed district manager of the Pittsburgh-Cleveland territory; *C. N. Maxfield* is now district manager of Detroit territory, covering Michigan and western Ohio; *Bernard R. Bristol* and *Charles H. Grosjean* have joined the New York sales staff; *A. E. Robinson* has joined the Chicago sales office, and *A. L. Aicher*, for years a member of the factory engineering staff, has joined the Philadelphia sales office.

Young Radiator Company, Racine, Wis., has appointed *Robert Grant* to act in a production and managerial capacity. Mr. Grant was formerly executive vice-president of the Fuller-Johnson Corp., Detroit, Michigan, and its subsidiaries.

Young Radiator Co., Racine, Wis., has appointed *George J. Haislmaier* sales manager of its contract products division. Mr. Haislmaier has been with Young since 1936 and until his most recent promotion had served as assistant sales manager and government specification engineer of the contract division.



Direct Fired Heaters

There is a new way to heat industrial buildings — without the medium of steam and the attendant requirements of boiler plant and distributing system. Dravo Direct Fired Heaters are economical, quick and easy to install. Each is a complete heat producer that starts at the snap of a switch.

Stock sizes available for quick delivery with from 750,000 to 1,500,000 B.t.u. output. Burning gas, oil or coke oven gas, these heaters give heat transfer efficiencies up to 86.5%. They can be installed for temporary heat during construction and retained as a permanent system.

There is a 12-page catalogue in the current issue of Sweet's that shows just how these heaters can be used singly or in combinations to provide a modern efficient heating plant for any industrial building. If you are interested in quick economical heat refer to your copy of Sweet's or write for Bulletin 502 and find out all of the details about this new way of heating.

SEE OUR CATALOG IN SWEET'S

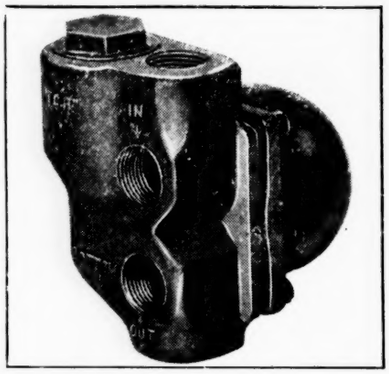
DRAVO CORPORATION

Machinery Division — Heater Department

DRAVO BUILDING · PITTSBURGH, PA.

4800 Prospect Avenue, Cleveland — Broad Street Station Building, Philadelphia

Why use Larger Traps when this "LITTLE GIANT" does the work?



STERLING No. 69

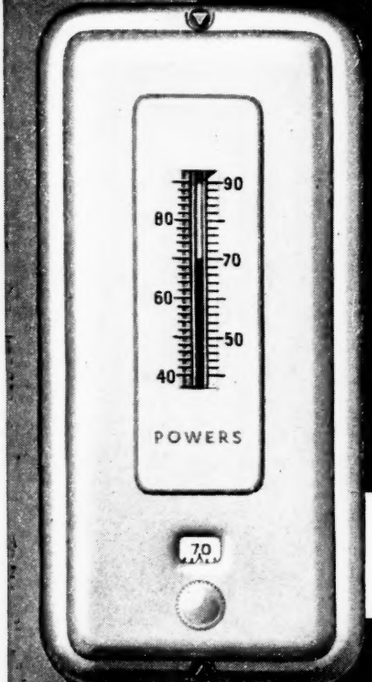
Float and Thermostatic Trap

The No. 69 efficiently takes the place of many larger traps on Unit Heaters and Ventilators. Only 3¼x4¾x5" in size, weighing only 7 lbs., it has capacities up to 1300 lbs. of condensate per hour at 20 lbs. steam pressure. Easy to clean, simple to install, with alternate inlets and outlets. Saves the cost of larger, bulkier and more expensive traps. Write for latest bulletin 383.

STERLING, INC.

3732-L N. Holton St. ★ Milwaukee, Wis.

GRADUAL CONTROL



has been an outstanding feature of Powers regulation since 1891. With this type of control, valves or dampers are opened or closed **gradually**, which results in exceedingly close regulation and the maximum of comfort obtainable with automatic control.

● THE POWERS REGULATOR CO., 2718 Greenview Ave., Chicago—231 E. 46th St., New York. Offices in 47 Cities. 43

WRITE FOR BULLETIN NO. 200

POWERS TEMPERATURE and HUMIDITY CONTROL

NEW TRADE LITERATURE

Air Outlets. A 4-page standard size folder on the company's Aerofuse outlets and featuring the fact that these outlets are now available in steel. Folder includes description, information on installing, drawings showing the different types available, and a list of the company's representatives. TUTTLE & BAILEY, INC., NEW BRITAIN, CONN.

Compressors. A 20-page catalog, No. 458, profusely illustrated with installation photographs in a wide variety of plants, describing the company's latest designs in large-volume, high-pressure centrifugal compressors. Starting with a survey of basic principles, the catalog covers important phases in design, construction and application. Also included is information on application, methods of drive, lubrication and control. B. F. STURTEVANT CO., HYDE PARK, BOSTON, MASS.

Fiberglas. An impressively arranged and bound booklet entitled "Third Anniversary" and published to celebrate the third birthday of the Owens-Corning Fiberglas Corporation. Sample advertisements are included from the days when Fiberglas was announced and also at the times of the first and second anniversaries of the company. The latter half of the book is devoted to illustrations and text explaining the part Fiberglas is playing in the defense program. OWENS-CORNING FIBERGLAS CORPORATION, TOLEDO, OHIO.

Humidification. An 8-page bulletin, in color, devoted to the Armstrong steam type humidifiers. Gives information on facts that should be known about industrial and comfort humidification, and includes tabular data on hygroscopic materials. Descriptions, drawings, and engineering data on the company's unit humidifier, explosion proof humidifier, and floor type humidifier together with a page of data and instructions on how to select humidifiers, and a page on hookup diagrams and recommended pipe sizes. ARMSTRONG MACHINE WORKS, THREE RIVERS, MICH.

Instruments. Catalog No. 8301 entitled, "Industrial Control Devices," and consisting of 56 pages in standard size, with color, and showing how production can be increased, costs lowered, and product quality improved from judicious use of automatic control of industrial processes. The catalog covers automatic control, electric and pneumatic, and combined electric and pneumatic. Definitions of technical terms are included. Specification and informative details are given for all types covering what they are, why they are used, features, capacities, construction and operation. THE BROWN INSTRUMENT COMPANY, DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR CO., PHILADELPHIA, PA.

Odors. A two-color, four-page bulletin describing the new portable Dorex type A odor adsorber, as well as illustrating a number of its many practical uses. DOREX DIVISION, W. B. CONNOR ENGINEERING CORP., 114 EAST 32ND STREET, NEW YORK, N. Y.

Steel. A pamphlet, loose-leaf, 5⅞ by 9⅛ in., 24-pages, comparing the SAE and the AISI system of steel identification. Booklet contains all of the latest official data for both of these systems and with direct comparisons of equivalent or alternate steels in tabular form. JOSEPH T. RYERSON & SON, INC., POST OFFICE BOX 8000A, CHICAGO, ILL.

Centrifugal Pumps. An eight-page book No. B-6059 which describes and illustrates the company's line of pumps. Included are pumps for handling capacities from 10 to 200,000 gpm and for heads ranging from 10 to 4200 ft. ALLIS-CHALMERS MFG. CO., MILWAUKEE, WIS.

Heat Circulator. A 4-page standard size folder describing the company's ceiling fan for circulating warm air in a room so as to reduce the ceiling temperatures during the heating season. REYNOLDS ELECTRIC COMPANY, 2650 W. CONGRESS ST., CHICAGO, ILL.

Pumps. A standard size, 22-page bulletin printed in color and devoted to the company's line of industrial pumps for diversified industrial applications. Describes features of the pumps, characteristics, and typical applications and drawings. Includes a profusion of illustrated case histories of various applications. POMONA PUMPS CO., 206 E. COMMERCIAL ST., POMONA, CALIF.

Refractories. A colorful new display card has been completed for distribution to dealers handling this company's line of refractory baffle plates. MCLEOD & HENRY CO., INC., TROY, N. Y.

Stokers. An 18-page catalog of the company's Poweram stoker for boilers developing up to 400 hp. Includes a list of prominent users, technical descriptions and illustrations of the stoker, information on fuel control, conveying, carburetion, combustion control and installation. THE IRON FIREMAN MANUFACTURING COMPANY, 3170 WEST 106TH ST., CLEVELAND, OHIO.

Waterproof Paint. A four-page, standard size bulletin describing the company's various rubber-base compounds, which are designed to stop leaks or seepage through brick, concrete, stucco or other types of masonry. When applied to metal, these Primoid products are reported to prevent corrosion or rusting, since they are resistant to oils, alcohol, gasoline, brine, acids and other chemicals. PRIMOID PRODUCTS CORP., 103 PARK AVE., NEW YORK, N. Y.

COMING EVENTS

DECEMBER 3-6. Annual meeting of the American Society of Refrigerating Engineers, St. Louis, Mo. Headquarters, Hotel Jefferson. Further information from ASRE, 37 West 39th St., New York.

JANUARY 12-15. Fourth All-Industry Refrigeration and Air Conditioning Exhibition. Stevens Hotel, Chicago. Further information from 111 W. Washington St., Chicago.

JANUARY 26-28. 28th Annual Convention of the National Warm Air Heating and Air Conditioning Association, to be held at the Benjamin Franklin Hotel, Philadelphia, Pa. Further information from the Association at 145 Public Square, Cleveland, Ohio.

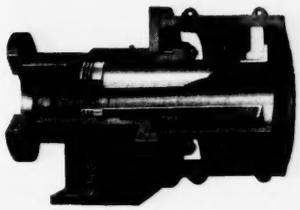
JANUARY 26-30. Seventh International Heating and Ventilating Exposition to be held at Commercial Museum, Philadelphia, Pa. Further information obtainable from International Exposition Company, Grand Central Palace, New York.

JANUARY 26-30. Annual meeting of the American Society of Heating and Ventilating Engineers, Philadelphia, Pa. Headquarters, Bellevue Stratford Hotel.

H&V'S PHOTOS

Page 16—Bob Bros. Studio, Buffalo.
Page 30-34—Samuel H. Gottscho, Jamaica, New York.
Page 36-40—Douglas Aircraft Co., Inc.
Page 41-42—The Austin Co., Cleveland.
Page 43-44—Westinghouse Electric and Mfg. Co.

Whether you are working on defense contracts or regular production, you cannot afford costly shutdowns in your service lines.



Install ADSCO Piston-Ring Expansion Joints—the slip type joints that can be unpacked and repacked under full operating conditions without interruption to service.

Get all the facts about this modern expansion joint that's always on the job . . . write for bulletin 35-15V.

ADSCO PISTON-RING EXPANSION JOINT
for steam, hot water, oil or gas lines

Piston rings in internal guide hold line pressure during unpacking and repacking operations.

Fully guided by internal and external guide.

Available in single or double joints for high pressures and high temperatures; flanged or beveled ends.

AMERICAN DISTRICT STEAM COMPANY NORTH TONAWANDA, N. Y.

Making "UP-TO-DATE" Steam Line Equipment for Over 60 Years.

ADSCO PISTON RING JOINTS
Can Be Packed Under Pressure

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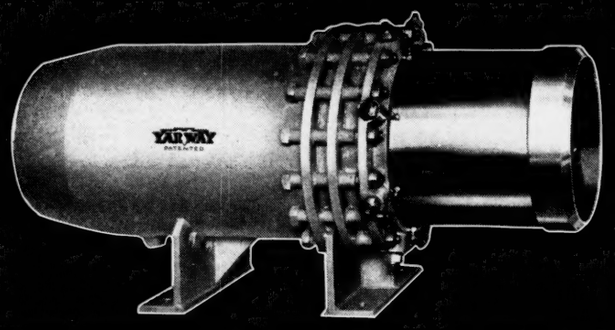

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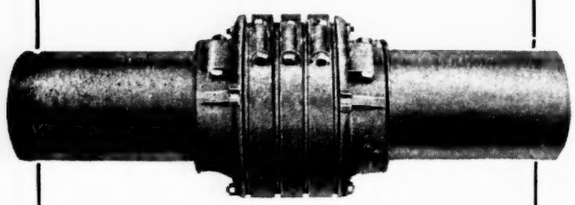
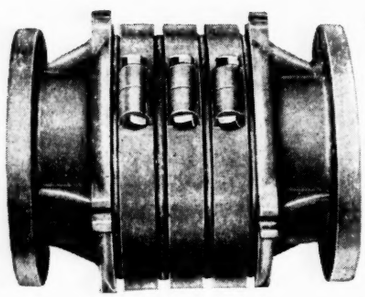
A BETTER INVESTMENT

Safer Principal ★ Higher Return

BADGER
EXPANSION
JOINTS





Badger Expansion Joints are a better investment because they have greater values designed and built into them.

What are those "Safer Principal" values?

The Directed Flexing movement is the culmination of a series of improvements in corrugated type expansion joints brought about by Badger engineers. This movement, by means of the specially-shaped all-curve corrugations and corresponding equalizing rings, keeps flexing stresses distributed.

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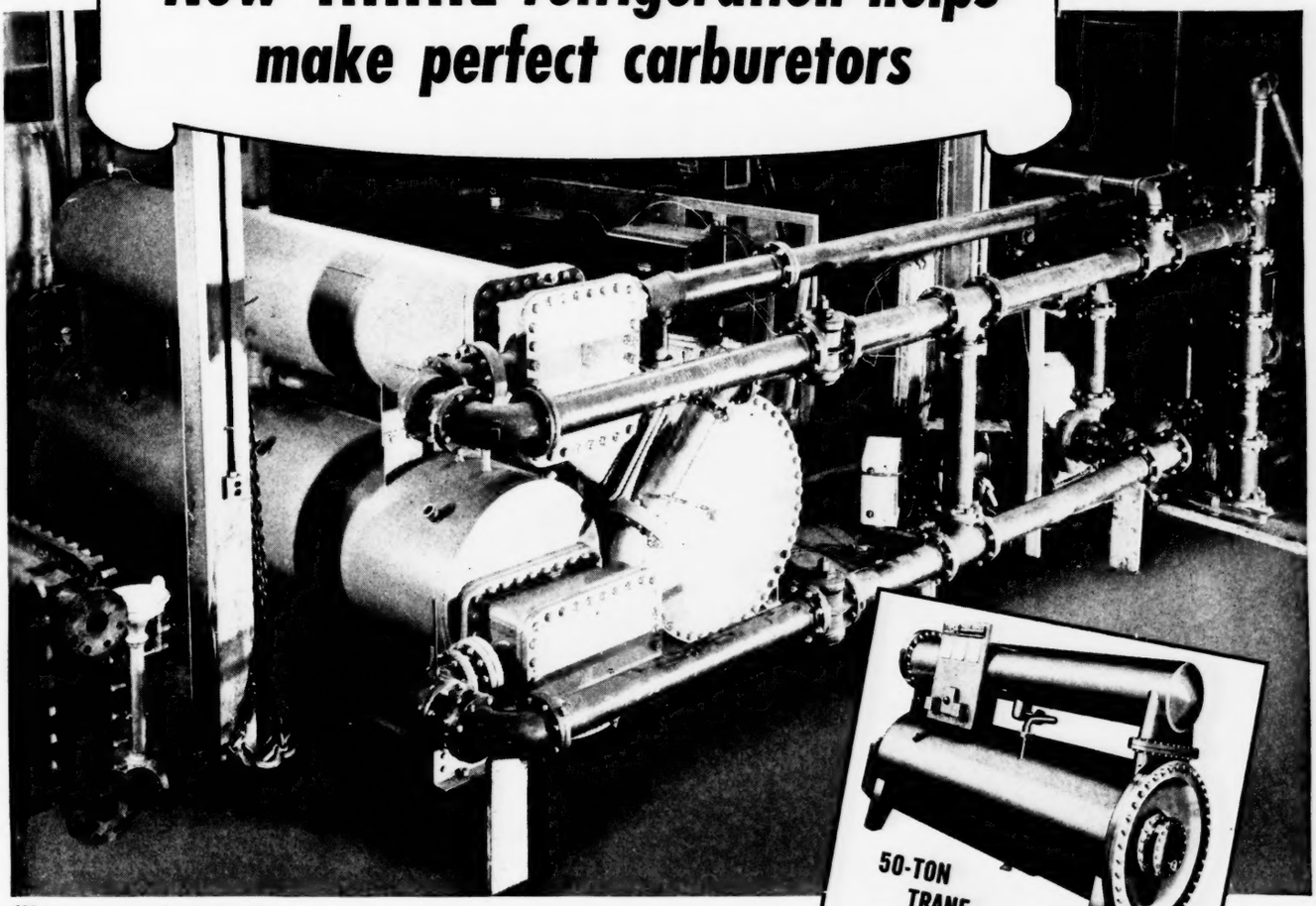
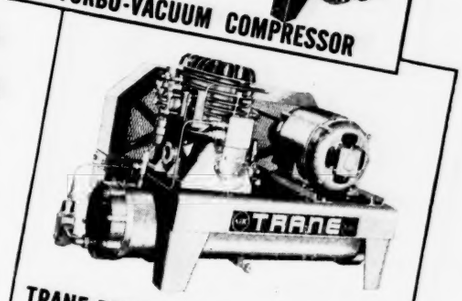
New TRANE refrigeration helps make perfect carburetors

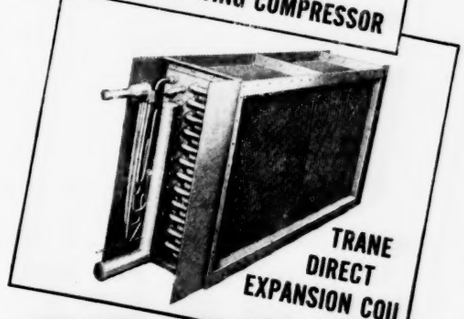


200-ton unit undergoing factory test

50-TON TRANE TURBO-VACUUM COMPRESSOR



TRANE RECIPROCATING COMPRESSOR



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Four 100-ton Trane Turbo-Vacuum Compressors at Wayne Division, Bendix Aviation Corporation

THIS NEW TRANE development represents an outstanding contribution to air conditioning progress which greatly simplifies the equipment arrangement on large jobs. Available in 50, 70, 100 and 200-ton sizes. Easy to install and place in operation.

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The complete line of Trane heating and air conditioning equipment includes, in addition to Turbo-Vacuum Compressors, Reciprocating Compressors, Heating and Cooling Coils, Unit Heaters, Convectors, Steam and Hot Water Heating Specialties, Fans, Climate Changers, Self-Contained Air Conditioners, Pumps and related equipment—all of which has a multitude of applications vitally important to American industry as well as many governmental agencies today.

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THE accurately formed straight segments on each end of every WeldELL are placed there for *your* benefit—to give *you* better engineered piping at lower cost.

They keep the weld away from the zone of highest stress, make lining up easier and facilitate the use of slip-on flanges with WeldELLS.

Tangents provide just one of *eight* good reasons for insisting on WeldELLS. Seven other extra value features are listed below.

►WeldELLS and other Taylor Forge Fittings for Pipe Welding and Forged Steel Flanges are stocked by authorized distributors in all principal cities. Ask your local distributor for a copy of Taylor Forge Catalog No. 401.

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WeldELLS have *everything*—

No other fittings for pipe welding combine these eight features. In addition to tangents these features are:

1. **Seamless**—Greater strength and uniformity.
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3. **Selective reinforcement**—provides uniform strength.
4. **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
5. **Wall thickness never less than specification minimum**—assures full strength and long life.
6. **Machine tool beveled ends**—provide best welding surface and accurate bevel and land.
7. **The most complete line of Welding Fittings and Forged Steel Flanges in the World**—insures complete service and undivided responsibility.

SEE ESSENTIAL MODERN AIDS TO NATIONAL DEFENSE THROUGH HEATING, VENTILATING, AIR CONDITIONING

"Because heating, ventilating and air conditioning are essential industries, they enter into every industrial and public building program. For the army camp or home to maintain comfort, efficiency and the health of the occupants, heating, ventilating and air conditioning must play an important part. *For this reason, the exhibits of manufacturers at the 7th International Heating and Ventilating Exposition* take on increasing importance."

Walter L. Fleisher,
Pres. A.S.H.V.E.

Your future depends on how well you can help to plan and equip heating, ventilating and air conditioning installations for defense plants and housing now; and on how well you can meet post-war requirements in your field.

Coincident with the dates of the Exposition, the American Society of Heating and Ventilating Engineers will convene its 48th Annual Meeting. The National Warm Air Heating and Air Conditioning Association and other organizations will meet during the same week.

The past two years have been marked by changes in needs, in equipment, appliances, materials and methods. Keep up with the ever-changing picture. See for yourself what's new and good. A few days spent at this biennial exposition will bring you first-hand acquaintance with what leading manufacturers are offering.

Engineering specialists in attendance at exhibits will welcome discussion, consultation and interrogation. They will provide every opportunity for demonstration and comparison. What you can see, hear, and learn here will help you for years to come. Don't pass up this opportunity. Admission is by registration. Be sure to come.

7th INTERNATIONAL HEATING & VENTILATING EXPOSITION
The Air Conditioning Exposition
COMMERCIAL MUSEUM • PHILADELPHIA • JANUARY 26-30, 1942
Under the Auspices of American Society of Heating and Ventilating Engineers

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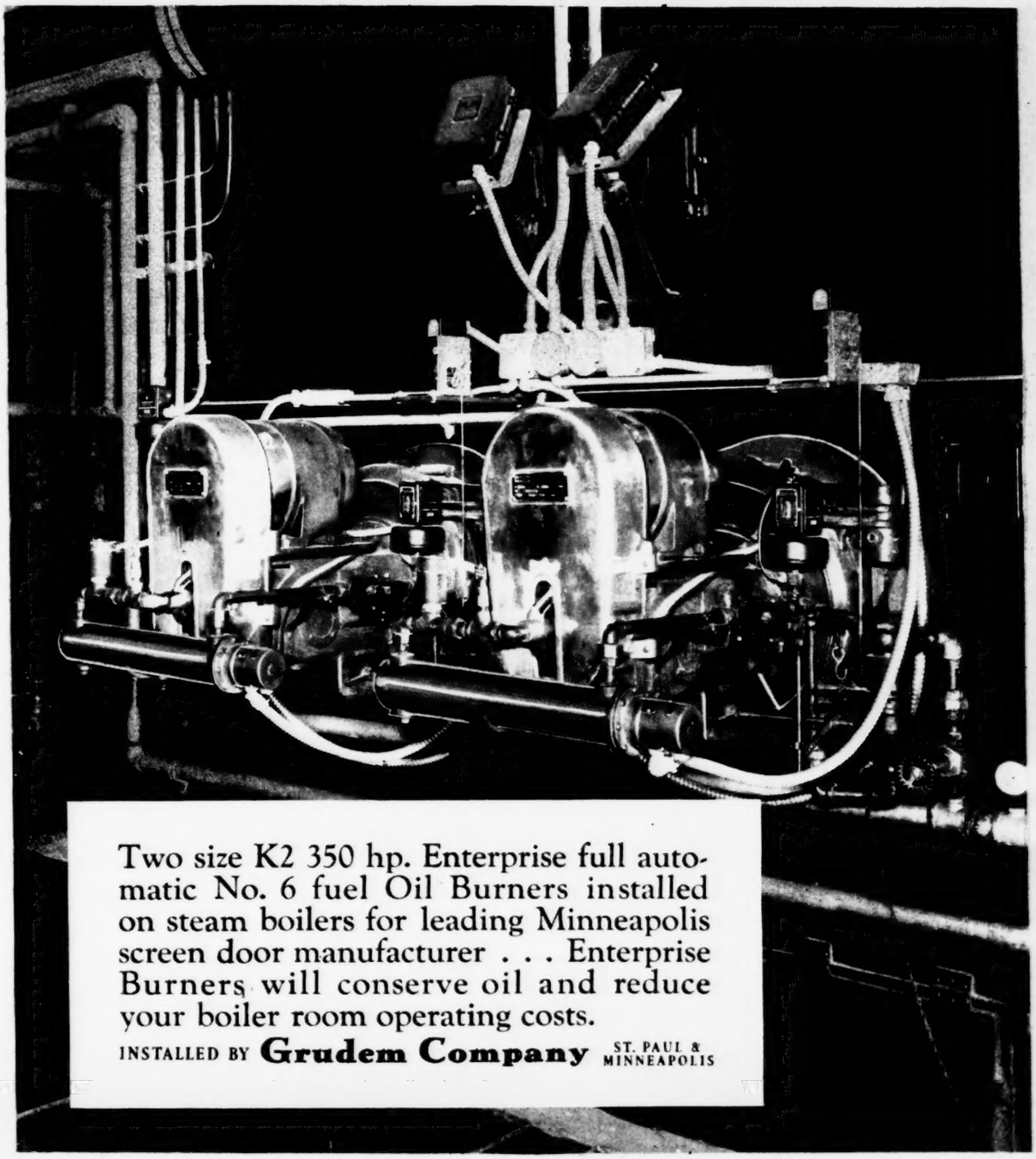
Heavy Oil Burner

the choice for Industrial and Commercial use



Two size K2 350 hp. Enterprise full automatic No. 6 fuel Oil Burners installed on steam boilers for leading Minneapolis screen door manufacturer . . . Enterprise Burners will conserve oil and reduce your boiler room operating costs.

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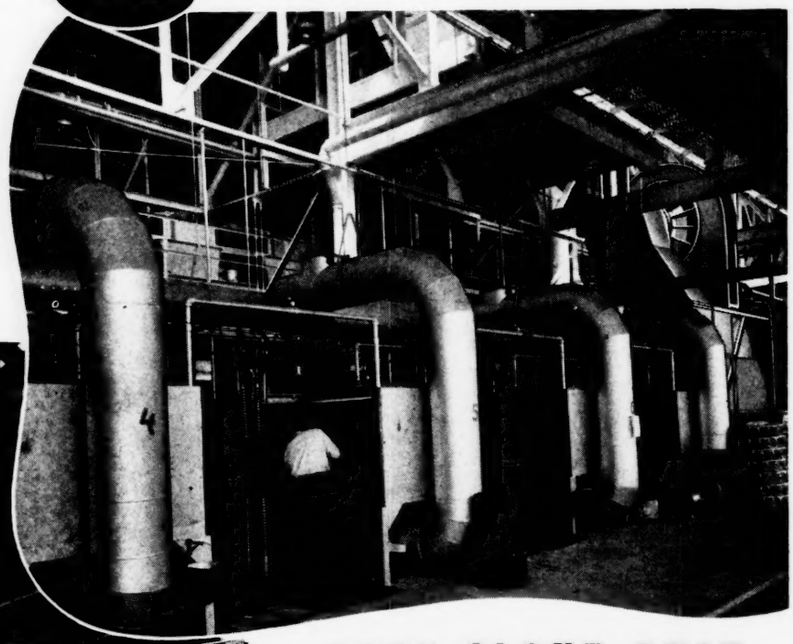
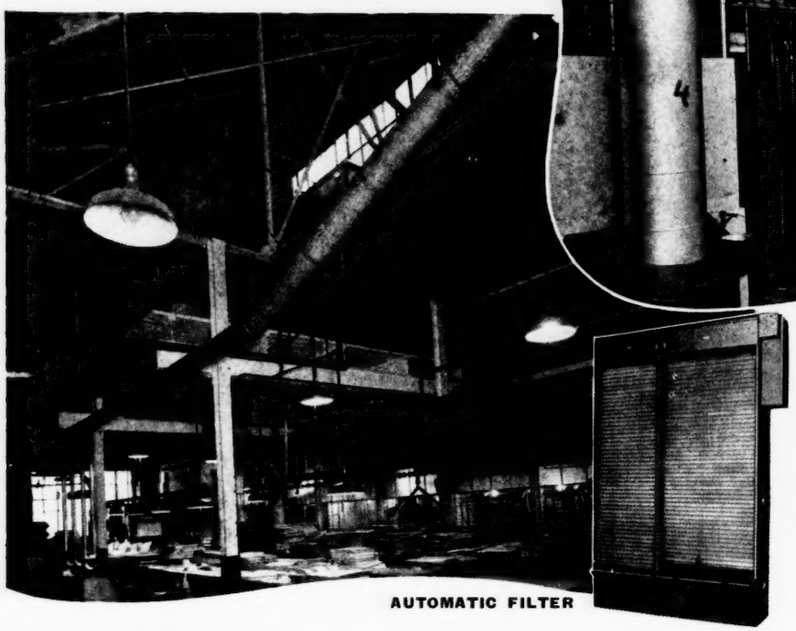
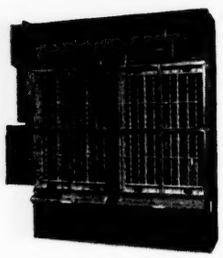
AAF FILTERS SUPPLY DUST-FREE AIR TO THIS LARGE SYNTHETIC ENAMEL DRYING ROOM





AUTOMATIC FILTER

ROTO-CLONE DUST CONTROL EQUIPMENT IN USE BY THE WRIGHT AERONAUTICAL CORPORATION



ELECTRO-MATIC FILTER

Where the highest degree of air cleanliness is required the Electro-Matic filter stands out as the most efficient self-cleaning air filter on the market today. It removes not only the atmospheric dust and soot collected by other types of filters but also smoke, fine dust particles, oil vapors, and fumes. Write for Bulletin No. 250C.

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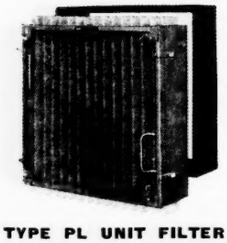
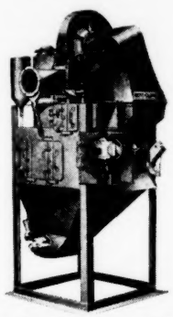


TYPE PL UNIT FILTER

This filter is in general use for commercial and industrial air cleaning where dust concentrations are not abnormal. It is readily adaptable to limited space, since as many units as necessary may be assembled in any desired pattern. Also tested and listed by the Underwriters' Laboratories. Ask for Bulletin No. 230B.



TYPE W ROTO-CLONE

The Type W Roto-Clone embodies the same principle of dynamic precipitation as the Type D Roto-Clone with the addition of water sprays which make possible the collection of the lightest and finest dust particles by wetting. Especially suitable for heavy dust concentrations and dust conditions involving a wide range of particle sizes. Ask for Bulletin No. 274A.

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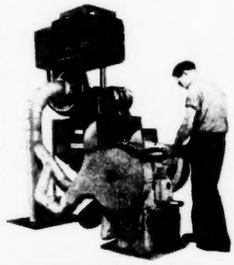
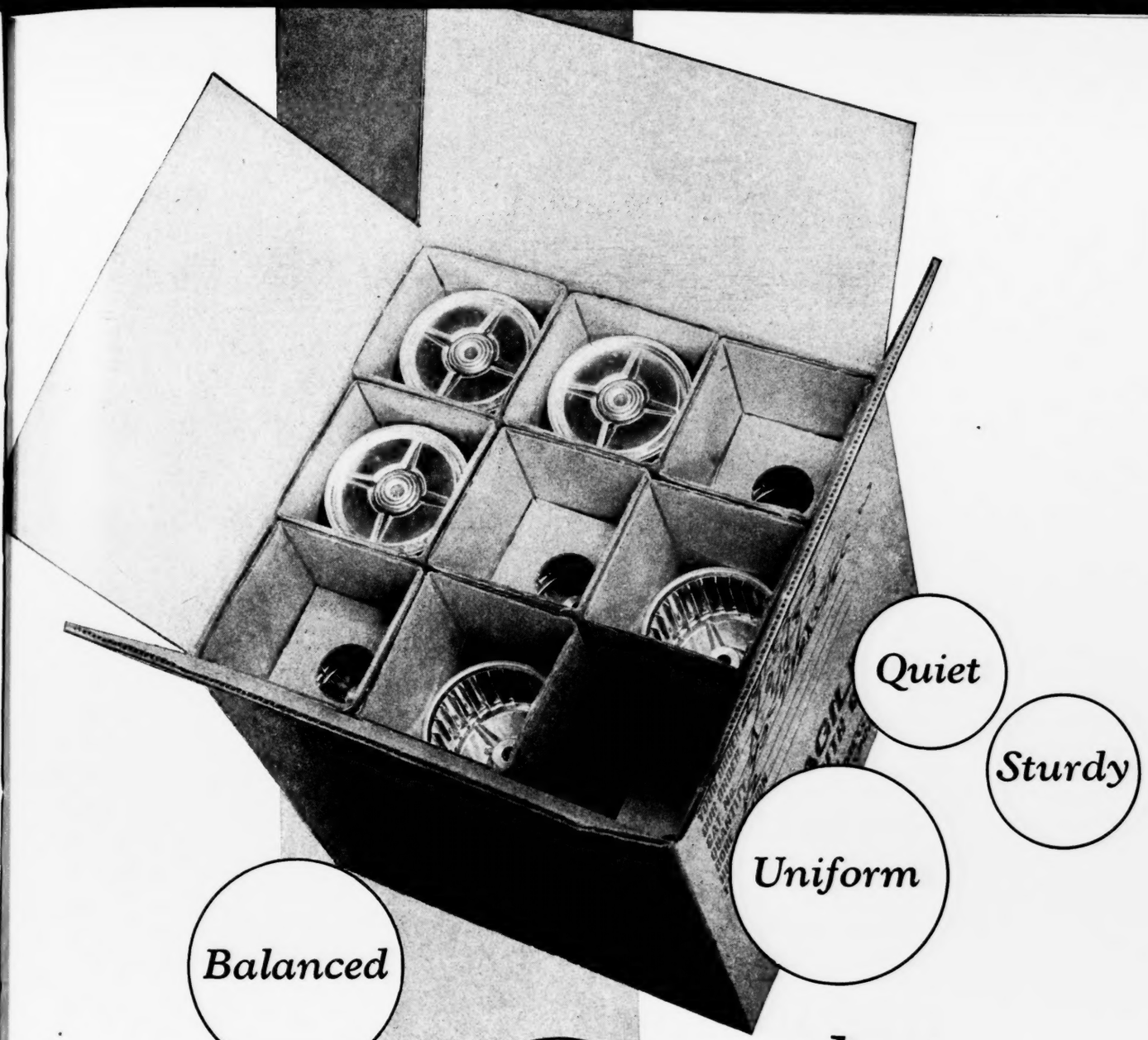


SELF CONTAINED ROTO-CLONE UNIT

The self-contained Roto-Clone is a complete dust control system including dust storage hopper and filter to clean the exhaust air so it may be recirculated into the workroom. May be located near the dust producing machine, on the floor, or overhead and connected to the exhaust hood with flexible tubing. Ask for Bulletin No. 272.

AMERICAN AIR FILTER CO., INC.
INCORPORATED
292 CENTRAL AVENUE LOUISVILLE, KY.

AIR FILTRATION AAF DUST CONTROL



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In existing buildings of almost every type, the fuel-saving Webster Moderator System has solved the problem of tenant discomfort and wasteful heating. The cooperation and service of the Webster Organization are freely offered to help you pre-determine the amount of savings possible with Webster Heating Modernization Programs. Address: Warren Webster & Company, Camden, N. J.

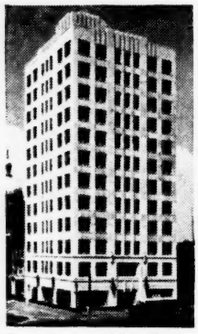
OWNERS SAVE STEAM WHILE TENANTS GET HEATING COMFORT

Webster Moderator System Gives Heating Satisfaction in Harrisburg Building

DESIRED HEAT IN EVERY ROOM

Economy Results from Delivery of Steam According to the Need for Heat

Harrisburg, Pa.—The 12 - story State Street Office Building is achieving the apparently conflicting objectives of comfort and economy as the result of installing a Webster Moderator System of Steam Heating in 1937.



State Street Office Bldg., Harrisburg, Pa.

Better heating results from delivery of steam according to need. Between May, 1938, and April, 1940, the Building required 5,800,000 lbs. of steam for heating. This represents 360 lbs. of steam per sq. ft. of radiation per season or .0666 lbs. of steam per sq. ft. of radiation per degree day—very economical operation for buildings of this type.

As a part of the installation, 202 radiators were equipped with Webster Radiator Supply Valves and Thermostatic Radiator Traps.

Herre Brothers, of Harrisburg, made the heating installation. There is a total of 8,050 square feet of installed direct radiation.

The State Street Office Building was designed by William Lynch Murray, Harrisburg architect. It is owned by the Payne - Shoemaker Company. Charles S. Urich is Building Manager. Steam is supplied from the mains of the Pennsylvania Power & Light Co.

Facing the Building is the Pennsylvania State Capitol Group, where five Webster Moderator Systems provide comfort for state employees and substantial steam savings.

VILLANOVA COLLEGE SOLVES PROBLEM OF HEAT DISTRIBUTION

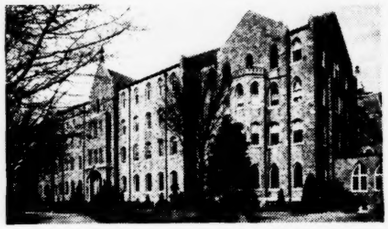
Webster Moderator System Makes Possible 25-30% Reduction in Annual Steam Consumption

CUTS COSTLY WINDOW OPENING

Steam Delivery to Radiators is Adjusted Automatically by Outdoor Thermostats

Villanova, Pa.—Villanova College, one of America's leading Catholic educational institutions, solved the heating problem in three College buildings by installing Webster Moderator Systems in 1940.

The buildings are Mendel Hall, including a dormitory, classrooms and administrative offices; Fedigan Hall and Alumni Hall, both dormitories.



Mendel Hall, Villanova College, Villanova, Pa.

"We are satisfied that we have found the ideal method of heat control for school or college buildings," says John Lawson, Controller. "We are getting exactly the temperatures we want at a saving of 25 to 30 per cent in steam consumption.

"We are particularly pleased with the control of steam delivery by the Webster Outdoor Thermostat feature of the Moderator System. This makes the heating of each of our buildings independent of window opening, saves steam."

The Superintendent of Buildings and Grounds is responsible for the well - planned operating schedule which assures maximum comfort from the Webster Systems.

Galligan Brothers, of Philadelphia, acted as modernization heating contractors.

The heating of two more Villanova College buildings was brought up-to-date in 1941 with Webster Moderator Systems.

HOME OF ROCHESTER DEMOCRAT-CHRONICLE CUTS HEATING COSTS

Webster Moderator System Helps 5-Story Newspaper Building to Save $738 in 6 Months

INCREASES HEATING COMFORT

Satisfactory Heating Provided in all Sections, including Press Room and Offices

Rochester, N. Y.—Heating costs in the Democrat and Chronicle Building were reduced $738.80 in the first six months after completion of a Webster Heating Modernization Program.

This substantial saving is a result of the improved steam distribution secured with a Webster Moderator System of Steam Heating.

Democrat and Chronicle Building Rochester, N. Y.

Neal Murphy, Business Manager of the Democrat - Chronicle, one of the famous Gannett newspapers, says:

"During the four years previous to heating modernization, we required 410.1 lbs. of steam per degree day to heat our building. With the Webster Moderator System, we require only 240 lbs. of steam per degree day and we are getting much better heat distribution.

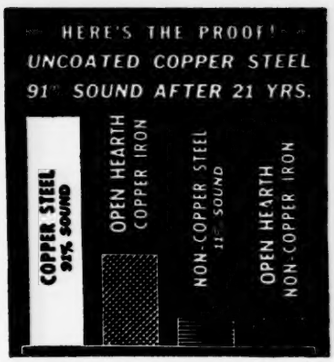
"Our experience here has led the Gannett Company to install the Webster Moderator System in our Utica Observer - Dispatch Building, Utica, New York."

The Democrat and Chronicle Building is heated by steam from the street mains of the Rochester Gas & Electric Company. The savings are based on the difference between present and past steam consumption.

In every section of the building—mechanical department, pressroom and offices—comfort has been increased. There is a total of 3,323 square feet of installed direct radiation.

U·S·S COPPER STEEL SHEETS

last longer ...easier to fabricate!



This chart, compiled from inspection reports of the Committee on Corrosion of Iron and Steel, A.S.T.M. Proceedings 1937, shows results of atmospheric corrosion tests carried on at Annapolis, Md., from 1916 to 1936. After 21 years' exposure, 91% of COPPER STEEL sheets remained "sound" (unperforated). Other materials were decidedly inferior.

U·S·S Copper Steel Sheets have four outstanding qualities that make them the first choice of many leading sheet metal workers and fabricators. First, sheets of U·S·S Copper Steel are easy to fabricate—they make possible true bends, tight seams and neat joints—saving time and money on the job. Second, they have two to three times the resistance of plain steel to atmospheric corrosion. Third, they have superior resistance to corrosion caused by smoke, gases and chemicals. And fourth, the added cost of U·S·S Copper Steel Sheets is so low that it makes little difference in the completed installation or fabricated product.

U·S·S Copper Steel Sheets are unusually uniform in gage, size and working characteristics — they are manufactured in both galvanized and hot rolled grades. Write to one of the companies below for our free booklet of helpful information.

U·S·S COPPER STEEL SHEETS

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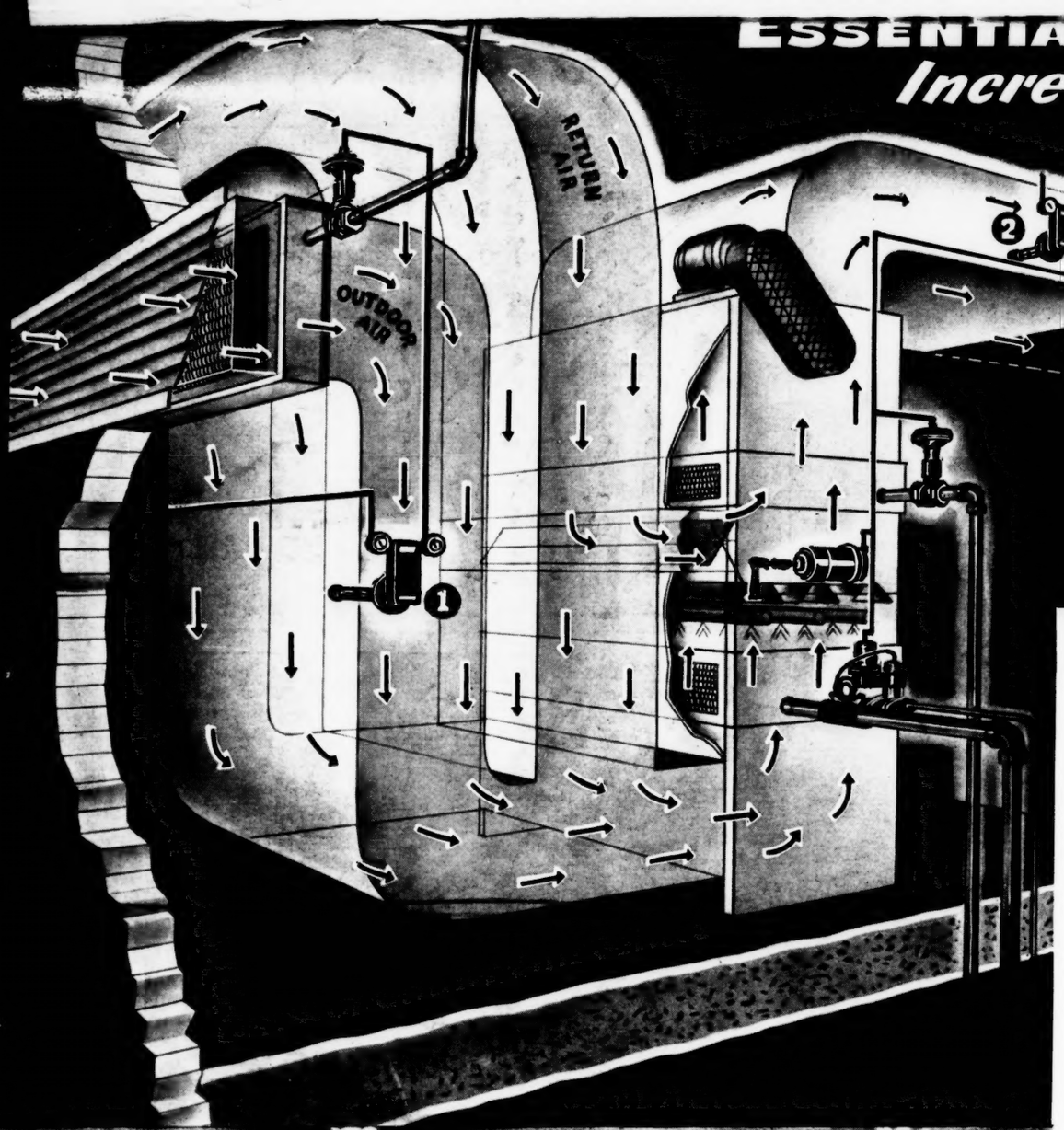
COLUMBIA STEEL COMPANY, *San Francisco*
TENNESSEE COAL, IRON & RAILROAD COMPANY, *Birmingham*

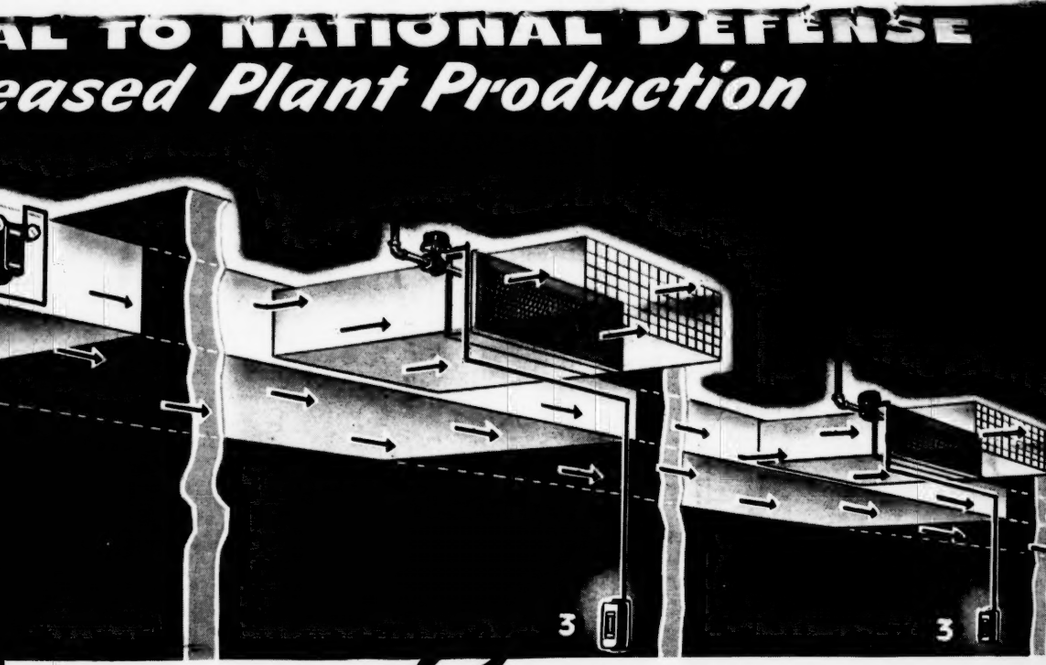
Scully Steel Products Company, Chicago, *Warehouse Distributors* · United States Steel Export Company, New York

UNITED STATES STEEL

ESSENTIAL TO NATIONAL DEFENSE

Increased Plant Production





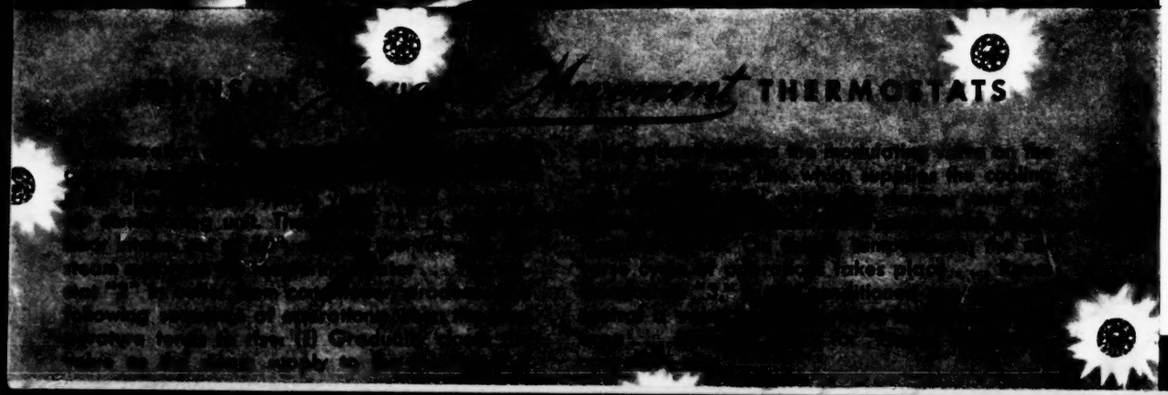
Enlist

JOHNSON "Proper Sequence" CONTROL

FOR SPACE CONDITIONING

THERE must be no bogging down in the rate of production by American industries. "SPEED UP" is the slogan of today. Only when temperatures and humidities are maintained at proper levels can certain manufacturing operations be carried on successfully, without "shut-down losses". Special areas, such as test chambers, calibrating rooms for measuring instruments, curing rooms, and storage spaces, in many instances, must be provided with controlled conditions. Processing machinery, too, dipping tanks, kilns, vats, dryers and coolers, require accurate control of temperatures . . . The nation-wide Johnson organization has been built especially to furnish and install automatic temperature control for just such purposes. The entire problem is solved by Johnson men, from preliminary engineering recommendations down through manufacturing and installing the equipment. There is no division of responsibility, no delay! Ask for a Johnson engineer, from a nearby branch office, or send for descriptive bulletins relating to your particular problems. There is no obligation, of course.

JOHNSON SERVICE COMPANY, MILWAUKEE, WIS., AND DIRECT BRANCH OFFICES IN ALL PRINCIPAL CITIES



JOHNSON

Automatic TEMPERATURE AND AIR CONDITIONING *Control*